'40 Million Salmon Might Be Wrong'
Ecological Worldviews and Geoengineering Technologies: The Case of the Haida Salmon Restoration Corporation

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King's College London

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Ecological Worldviews and Geoengineering Technologies: The Case of the Haida Salmon Restoration Corporation

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Abstract

This thesis employs Hedlund-de Witt's (e.g. 2012) Integrative Worldviews Framework as an interpretative lens to explore the ways in which diverse ontological, epistemological and axiological assumptions about the role and nature of 'nature' and human agency can be interpreted from 'geoengineering' discourse.

It does so through an opportunistic case study of the 2012 Haida Salmon Restoration Corporation's ocean fertilization project. The HSRC case study, anchored in notions of place and identity, marks a novel entry point into social research on geoengineering and facilitates a more situated engagement with geoengineering in keeping with the traditions and tools of ethnography and geography.

Through an 'informed grounded theory' approach to analysis of the case-study discourse, bolstered by an interpretivist application of Q-Methodology, this thesis develops 7 issue-frames and 3 Q-factors that invoke different interpretations about what it means to be human, about the 'natural' or 'artificial' quality of technological mediation of the environment and about how knowledge gains legitimacy.

This thesis suggests that 'geoengineering' will always be performed and expressed through unique 'surface contents' and contextually specific meanings. However, interpretative resources described in relation to a range of other geoengineering proposals and through more abstract entry points into thinking about geoengineering also find salience through the study frames. 'Geoengineering' in Haida Gwaii connects with wider cultural meanings and literatures that consider the human relationship with nature. Furthermore, the study factors are suggested to have some interpretative overlap with ideal-typical 'worldview' heuristics described in earlier literatures that have sought to describe dominant currents of cultural meaning in contemporary Western society.

These factors therefore may serve as useful orienting heuristics for conceptualising general homologies of deeper, shared forms of reasoning about the role and nature of 'nature' and human agency shaping wider public contestation about geoengineering. Such 'ecological worldview' heuristics might help facilitate greater reflexivity in decision-making, but their limitations must remain at the heart of their application. Further research is needed to establish their usefulness for other geoengineering technologies and in other cultural contexts.

For all those who have dedicated their lives to the protection of the rainforests and coastline of British Columbia.

Your battles fought, and won, have been victories for us all.

Contents

List of Acronyms

BC – British Columbia

CBD – Convention on Biological Diversity

CDR – Carbon Dioxide Removal

CHN – Council of the Haida Nation

CT – Cultural Theory

ESRC – Economic and Social Research Council

GT – Grounded Theory

HOME – Hands Off Mother Earth

HSRC – Haida Salmon Restoration Corporations

IPCC – Intergovernmental Panel on Climate Change

IWF – Integral Worldviews Framework

KCL – King's College London

NEP – New Environmental Paradigm

NGO – Non Governmental Organisation

NRM – Natural Resource Management

OMVC – Old Massett Village Council

PCA – Principle Component Analysis

SPICE – Stratospheric Particle Injection for Climate Engineering

SRM – Solar Radiation Management

UBC – University of British Columbia

UEA – University of East Anglia

UN – United Nations

UNEP – United Nations Environment Program

WMO – World Meteorological Organization

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Acknowledgements

As I sit here with my completed thesis on the computer screen in front of me, it is near impossible to know where to begin thanking everyone who has helped me realise this dream. Without the support of so many this work simply would never have come to fruition and for this I will never be able to offer adequate thanks.

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Conferences and workshops have proved to be particularly stimulating intellectual experiences and fruitful settings for formulating ideas for this research. I would therefore also particularly like to thank the organisers and participants of the 2013 IASS Potsdam Religious and Spiritual Perspectives on Climate Engineering Conference and the 2013 Fourth Interdisciplinary Summer School on Geoengineering at Harvard University. I am especially grateful to Harvard University for sponsoring my attendance at the latter of these events.

Turning to my field setting I must start first by thanking the Haida Salmon Restoration Corporation (HSRC). Following an onslaught of media attention, (the likes of which an organisation many magnitudes larger would have struggled to respond to), by the time my research commenced the HSRC had all but shutdown communication with outside agencies. Yet the response that I received from the HSRC was overwhelmingly generous. Changes in senior management had facilitated a new openness and many HSRC affiliates and directors donated extensive time and energy to supporting my research process. This cooperation, effort and insight was fundamental to the success of this project and I am deeply grateful for the trust and assistance that I was afforded. Within the HSRC Jason McNamee deserves particular mention for championing participation in my research and for serving as a key gatekeeper. John Disney additionally kindly devoted substantial time to commenting on an earlier draft of chapter 5.

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Through the emotional process of 'leaving the field', the dissonance I have felt between this ethic of connection and my current life in central London has proven a challenging aftermath to my fieldwork. Experiences and friendships on these islands transformed Haida Gwaii from a field site, into a place that I too now care about profoundly. Indeed there is nowhere I would rather be than walking the sands of North Beach or picking huckleberries on the Dover trail. As I so often battle to stave off this longing I find solace in the realisation that my experiences in Haida Gwaii have become a part of who I am and I am sure that throughout my life I will always return to these magical islands.

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Chapter 1: Introduction

The fifth assessment report of the United Nations Intergovernmental Panel on Climate Change (IPCC, 2014a: 17) warns that "without additional mitigation efforts beyond those in place today, and even with adaptation, warming [of average global temperatures] by the end of the 21st century will lead to high to very high risk of severe, widespread and irreversible impacts globally". However mitigation progress has been slow and as global greenhouse gas emissions continue to rise, frustration is mounting and the story of anthropogenic climate change is taking new turns.

The desire for human control over climate and weather has a long history, emerging and re-emerging in different places, in different cultures, at different times and with different goals (Fleming, 2010). In more recent years these ideas have manifested with renewed enthusiasm in the idea of 'geoengineering' the climate as a partial solution to anthropogenic climate change. 'Geoengineering', the Royal Society (2009: 1) writes, is "the deliberate large-scale manipulation of the planetary environment to counteract anthropogenic climate change".

Techno-centric discourses of large-scale scientific innovation and intervention are often deployed to characterize geoengineering (Blackstock & Long, 2010). These in turn have been linked to the notion of a climate utopia and the hope that physical climates could be fashioned so as to match the needs and desires of the human imagination (Meyer, 2002; Porter & Lukermann, 1975). Yet as interest in geoengineering gathers, debate is spreading wider and deeper, drawing together an ever-greater range of stakeholders, political actors and interests, with multiple, and often competing, perceptions and understandings of why geoengineering may, or may not, be desirable and feasible (Hulme, 2014).

Perceptions and understandings of environmental problems such as climate change, and the subsequent policy responses that are deemed desirable are ever more understood to be deeply-seated within cultural, social and historical context (Howitt, 2001; Hulme, 2009; Jacobs & Mulvihill, 1995). The way such understandings are formed is both a culturally informed and idiosyncratic act (Schweder, 1984; Christie, 1992) and different groups are increasingly recognised as having diverse ways of viewing their relationship with climate, which give precedence to different issues and priorities, reflecting different experiences, interests and values (Bravo, 2009; Donner, 2011, 2007).

Diversity within multiple publics and stakeholders is beginning to be reflected in the multiplicity of the discourses that have been explored in existing social science research on geoengineering (e.g. Scholte et al., 2013). However to date these literatures have largely brought forth a limited range of voices. A select group of actors have been found to have disproportionately been given authority to

frame geoengineering in political and media realms and studies of perceptions of geoengineering have been largely focused within Western and anglophone contexts (see section 2.5).

Nevertheless, from these existing literatures, underlying assumptions about the nature-human relationship has been found to be an important influence on how people make sense of geoengineering (e.g. Corner et al., 2013; Macnaghten & Szerszynski, 2013; Porter & Hulme, 2013). As Kate Soper (2000[1995]: 2) writes, 'nature' is a "concept through which we pose questions about the more or less natural or artificial quality of our own behaviour and cultural formations [and] about the existence and quality of human nature". Human self-interpretation lies at the heart of the ways in which people conceive of and relate to the concept of 'nature' (Jenkins, 2005) since as Preston (2012: 198) explains, "['nature'] has served as a canvas against which humans have searched for, and found meaning in their lives". Contestation about 'geoengineering' accordingly draws on a long history of debate about the relationship between nature and humans. Different geoengineering narratives have been argued to carry different assumptions about the meaning and value of 'nature' (Porter & Hulme, 2013), different ideas about the meaning and risks of "messing with nature" (Corner et al., 2013; Macnaghten & Szersznski, 2013), different interpretations of the human condition (Clingerman, 2014) and diverse assumptions about what it means to "make" climate (Galarraga & Szerszynski. 2012).

Clingerman (2014) calls for more research to draw out the implicit philosophical assumptions about the nature of nature, technology and human agency that play out in human meaning-making about geoengineering. This thesis aspires to make such an empirical contribution in the belief that exploring diverging standpoints and generating a better understanding of the beliefs and values that underpin different attitudes and responses towards the idea of geoengineering will be fundamental to ensuring a more productive, creative, inclusive and equitable debate about this issue of great global consequence. Humanity has a history of concepts like 'development', 'globalisation' and 'management' amounting to the imposition of dominant ontological, epistemological and axiological assumptions on the rest of the world (Sillitoe, 2002; Kassam, 2002). In reference to climate change, for example, Bravo (2009) argued that dominant narratives in climate change discourse have silenced, ignored or devalued alternative epistemologies of the Alaskan Inuit. Mainstream Eurocentric approaches to management of the global environment have a long history of ontologically privileging solutions that fit within their own problem definitions (e.g. Howitt & Suchet-Pearson, 2006; Nader, 1996). The universe is, as fictional writer Douglas Adams (1980: 58) reflects, "a big unsettling place which, for the sake of a quiet life most people tend to ignore'.

In more recent years however there has been a sea-change in the paradigms that structure environmental governance and the emergence of politically influenced development discourses

(Kuper, 2003; Sillitoe, 2002), which have a ring of Bhabha's (1990: 208) 'third way' about them. Accounting for pluralism and diversity in environmental management and global decision-making is increasingly viewed as essential to building positive relations (Salafsky & Wollenberg, 2000) and achieving more sustainable outcomes (Chilvers, 2009; Kassam, 2002). This paradigm shift has opened up opportunities for realising the considerable value that can be gained from better comprehension of, and sensitivity to, alternative perspectives, beyond the dominant lines of thinking about environmental issues (Howitt, 2001; Potter et al., 1999). If then, as Clingerman (2014: 7) claims, geoengineering "challenges us to rethink our sense of being human" and "draw[s] us into a new relation with nature" (Galarraga & Szerszynski, 2012: 222), it is surely prudent to self-consciously and collectively define the terms of this new relationship.

This thesis draws conceptually on the work of Annick Hedlund-de Witt (2014, 2013a, 2013b, 2013c, 2012, Hedlund-de Witt & Hedlund-de Witt, 2015, *in press*) who operationalizes and defines the concept of 'worldviews' through five interrelated dimensions of 'ontology', 'epistemology', 'axiology', 'anthropology' and 'societal vision' (see section 3.4.3). Using this Integrative Worldviews Framework (IWF) as an orienting analytical heuristic, this thesis accordingly seeks to further understanding of the deeply held beliefs that people in different cultural, political and social contexts hold about climate, and hence of how different people conceive, legitimate and relate to the idea of geoengineering (Hulme, 2014, 2009). Within this framework, analysis is focused particularly on exploring how different ontological, epistemological and axiological assumptions about the nature of 'nature' and human agency may be employed to promote or resist the idea of geoengineering.

The following primary research question was therefore posed:

> **In what ways is it possible to extract and interpret diverse ontological, epistemological and axiological assumptions about the nature of 'nature' and 'human agency' from discourses which contest the desirability and feasibility of geoengineering?**

This research makes a particularly novel contribution to the existing literature by focusing exploration of this question on an opportunistic case study of an ocean fertilization project, conducted by the Vancouver-based Haida Salmon Restoration Corporation, and funded by Old Massett Band Council, a First Nations community from the British Columbian archipelago, Haida Gwaii. Because awareness of geoengineering is not high among the public, previous research on public perceptions of geoengineering has largely been dependent on research designs that have in some sense had to create the views that they seek to elicit, albeit using sophisticated techniques (Bellamy et al., 2013). News that the HSRC had released 120 tonnes of iron sulphate and iron

oxide into an ocean eddy 457 kilometers West of Haida Gwaii, broke in October of 2012, 12 months into my doctoral research. The case study was nevertheless pursued since, invoking a rare site of live debate about the desirability and feasibility of – at the very least – the geoengineering potential of ocean fertilization, this place-based experience of geoengineering marked a new entry point into thinking about perceptions of geoengineering and offered a unique opportunity to explore public meaning-making about geoengineering using the lens and tools of geography and ethnography. Furthermore, controversy about the HSRC's ocean fertilization experiment embroiled a very diverse set of actors who made sense of the geoengineering ambitions of the HSRC through a diverse range of cultural, political and educational experiences. These actors included Indigenous people, who have been previously excluded from public consultations on geoengineering. The case study therefore provided the opportunity to 'open up' (c.f. Stirling, 2008) the existing social science literature to a wider range of empirical perspectives

In this case study context the research question therefore became:

> **In what ways can diverse ontological, epistemological and axiological assumptions about the role and nature of 'Nature' and 'human agency' be extracted and interpreted from debate about the desirability and feasibility of the 'geoengineering' activities of the HSRC?**

Hedlund-de Witt's Integrative Worldviews Framework is designed to help facilitate a holistic, encompassing, systematic but dynamic exploration of 'worldviews' in empirical research. To render the concept more readily researchable Hedlund-de Witt articulates the five major aspects of worldviews into exemplary questions (see section 3.4.3). Using these questions as guiding heuristics, the following sub-questions were therefore defined:

1. What does contestation about the desirability and feasibility of the geoengineering ambitions of the HSRC project suggest about the different ways in which people may conceive of and relate to the concept of 'nature' and naturalness?

2. In what ways does debate about the HSRC construct different boundaries between 'natural' and 'human' worlds?

3. How do different secular, spiritual or religious beliefs shape these interpretations?

4. What forms of 'Nature' are afforded value through this debate?

5. What does debate about the HSRC's 'geoengineering' activities reveal about human self-interpretation and how is the role and purpose of the human being constructed through debate about the HSRC?

6. What forms of knowledge authorize different assumptions about the relationship between humans and nature and how do different forms of knowledge gain legitimacy in this debate?

The thesis schema presented in Figure 1.1 below begins to illustrate the research design through which I sought to operationalise an investigation of these research questions. The thesis is designed sequentially, with each chapter building upon the previous. Chapter 2 explores the wide-ranging literature through which the above research questions were defined. Alongside consideration of the research paradigm, chapter 3 establishes the research conceptual framework and defines the theory through which 'worldviews' and their interface with geoengineering discourse were conceptualised and investigated. Chapter 4 then offers an overview of the research methodology, establishing a 'cosmopolitan' approach to constructing the case-study field site and delineating two distinct phases to the research.

Phase one of the empirical research pursues multiple lines of interpretative ethnographic enquiry, including combinations of such techniques as participant observation, interviews of varying depth and formality, media and text analysis, and a focus group. The empirical output from this phase of the research is reported in chapters 5 and 6 of this thesis. Chapter 5 will illustrate that it is not possible to separate out reactions to the 'geoengineering' activities of the HSRC project in Haida Gwaii from local and global socio-ecological concerns or from local debates about natural resource use and access (c.f. Buck, 2014b). Thus in keeping with geographical traditions, chapter 5 offers an account of the HSRC project that seeks to contextualize the research, explore the significance of place and situate interpretations about the desirability and feasibility of the geoengineering ambitions of the HSRC within local experiences and histories.

From iterative grounded coding of the data, collected during this first very open stage of engagement with the case study field site, chapter 6 then proposes seven ways of framing the 'geoengineering' activities of the HSRC. In keeping with the research questions, these frames are

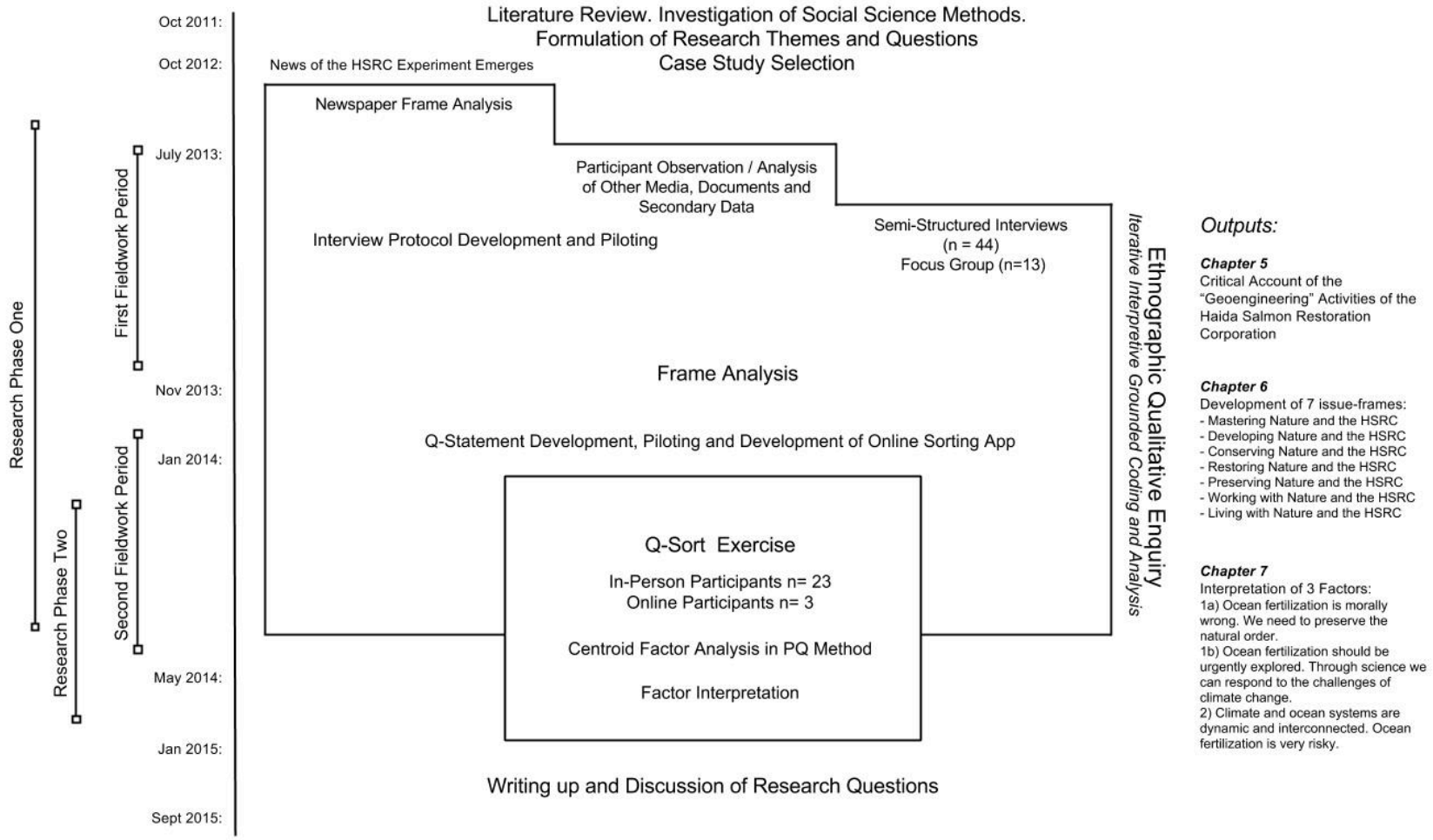
designed to speak to different themes in the ways in which participants and texts within the case study constructed the desirability and feasibility of the HSRC's 'geoengineering' activities in relation to different ontological, epistemological and axiological assumptions about the role and nature of 'Nature' and human agency. They construct different notions of 'nature' and 'naturalness', offer diverse interpretations about human role and purpose, construct different boundaries between 'natural' and 'human' worlds, are shaped by different secular, spiritual and religious beliefs, afford different forms of nature value and afford different forms of knowledge legitimacy.

The final empirical chapter of the research, chapter 7, then provides a more macroscopic compliment to this exploration of themes and frames, by reporting on a Q-Methodology study, employed to identify clusters of shared meaning about the role and nature of 'nature' and human agency in discourse about the desirability and feasibility of ocean fertilization. This second phase of research builds directly on the findings from phase one since the Q-statements, on which Q-methodology depends, were constructed to reflect and engage with different ontological, epistemological and axiological assumptions about the role and nature of 'nature' and human agency, discussed in the frame analysis in chapter 6.

These Q-statements were sorted by participants onto a fixed and normally distributed, single dimension and face-valid grid, according to what participants themselves deemed to be meaningful and significant. In a by-person factor analysis, these Q-sorts were then considered in terms of the entire configuration of responses produced by participants, to explore patterns of association between the measured variables, and to generate a small number of factors, that are used in chapter 7 to help interpret diversity and similarity across participants' views and preferences. By exploring the way in which different ontological, epistemological and axiological assumptions are connected and related by participants, this second phase of the research pays homage to the characterization of worldviews as socially constructed "overarching systems of meaning and meaning-making" (Hedlund-de Witt, 2012: 80).

Chapter 8 then draws together the analysis from each of the empirical chapters to answer the research questions, whilst offering some reflections on potential avenues for future research.

Figure 1.1 Thesis Schema



Chapter 2: Why We Disagree About Geoengineering

2.1 The Emergence of the Geoengineering Debate

Weather and climate are often understood as the "domain of the gods" (Donner, 2011, 2007; Hulme, 2014). However the desire for human control over climate and weather also has a long history, emerging and re-emerging in different places, in different cultures, at different times and with different goals (Fleming, 2010). The "Storm King", James Pollard Espy of the 1830s, for example, sought to stimulate rainfall in times of drought; a practice continued to this day by a number of agricultural companies who employ contractors to seed clouds over their most valuable agricultural land. Since the 1940s both the US and Soviet Union governments have explored weather modification interventions in pursuit of national security and battleground advantage[1] (Victor et al., 2009; Fleming, 2007). While in the 1965 "Restoring the Quality of our Environment" report, the first ever US presidential briefing on the dangers of anthropogenic climate change, geoengineering was advocated to tackle concerns about the impacts of increased atmospheric carbon dioxide concentrations, where emissions reductions were not even considered (US President's Scientific Advisory Committee, 1965: 127).

More recently, ambitions for *global* control over *global* climate (Hulme, 2014; Tollefson, 2010) have gained new resonance in the face of rising concerns about anthropogenic climate change. Paul Crutzen's (2006) seminal essay in the journal *Climatic Change,* 'Albedo enhancement by stratospheric sulphur injections: A contribution to resolve a policy dilemma?' is often credited for sparking renewed interest in geoengineering within academic, policy, media and popular realms (Buck, 2012a; Hulme, 2014; Nerlich & Jaspal, 2012; Porter & Hulme, 2013). A Nobel Laureate attesting that the stagnant and "grossly unsuccessful" (Crutzen, 2006: 212) global response to anthropogenic climate change necessitated serious exploration of an alternative "escape route against strongly increasing temperatures" (Crutzen, 2006: 216), gave renewed credibility to the idea of geoengineering and contributed to a new public discourse (Hulme, 2014).

The climate tipping point metaphor, gaining purchase after James Hansen told the American Geophysical Union "we are on the precipice of climate system tipping points beyond which there is no redemption" (Hansen, 2005: 8, see also Bellamy & Hulme, 2011; Russill & Nyssa, 2009), and concerns that significant climate change has become 'locked-in' (UNEP, 2013), have added urgency to Crutzen's narrative. So now, less than a decade later, debate about geoengineering is spreading wider and deeper, rallying an ever-greater range of stakeholders, political actors and interests

[1] Such practices were restricted by the ensuing 1976 UN Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques.

(Scholte et al., 2013). Scientific and media interest in geoengineering has soared (Belter & Siedel, 2013; Porter & Hulme, 2013). Legal deliberations are gaining traction (Markusson et al., 2014). And, marked by its inclusion within the Intergovernmental Panel on Climate Change's Fifth Assessment report (e.g. Edenhofer et al., 2014), geoengineering has transitioned from fringe to more mainstream policy discussions (Stilgoe, 2013), positioned as a third policy response alongside mitigation and adaptation (Bellamy et al., 2013; Nurse, 2011).

2.2 What is 'Geoengineering'?

Figure 2.1 Example definitions of geoengineering:

American Meteorological Society, (2013): "Deliberately manipulating physical, chemical, or biological aspects of the Earth system [to reduce the risks of anthropogenic climate change]".

Bipartisan Policy Centre (2011: 3): "The task force defines the term "climate remediation" to mean intentional actions taken to counter the climatic effects of past greenhouse gas emissions to the atmosphere".

[HOME] HandsOffMotherEarth (2014): "Geoengineering refers to large scale schemes that intend to intervene in the earth's oceans, soils and atmosphere with the aim of combatting climate change".

IPCC (Stocker et al., 2013: 29): "Methods that aim to deliberately alter the climate system to counter climate change".

Oxford English Dictionary (2014): "The deliberate large-scale manipulation of an environmental process that affects the earth's climate, in an attempt to counteract the effects of global warming".

Royal Society (2009: 1): "The deliberate, large-scale manipulation of the planetary environment in order to counteract anthropogenic climate change".

United Nations Convention on Biological Diversity (UNCBD, 2012): "A deliberate intervention in the planetary environment of a nature and scale intended to counteract anthropogenic climate change and its impacts".

Washington Geoengineering Consortium (2013: 7): "An umbrella term used to describe any number of technological interventions that are being imagined or developed to mitigate climate change or to blunt its impacts".

Geoengineering has been variously defined (see Figure 2.1), and described using an assortment of alternative linguistic framings; 'geoengineering', 'climate engineering', 'climate modification', 'earth systems engineering', 'terraforming', 'climate remediation' and 'climate intervention' being some of the most established. The most widely cited definition of geoengineering emerged from the Royal Society's 2009 assessment report, which described geoengineering as "the deliberate, large-scale manipulation of the planetary environment in order to counteract anthropogenic climate change" (Royal Society, 2009: 1). These themes were echoed by David Keith (2000) too, who argued that geoengineering must be large in scale, intentional and countervailing. That is to say it must be a deliberate attempt to offset the effects of anthropogenic climate change and must have trans-boundary or planetary effects. Intentionality is also key for Jamieson (1996) and Schelling (1996),

while others (e.g. NAS, 1992) blur this distinction, labelling anthropogenic climate change 'inadvertent' geoengineering. Fleming (2010) meanwhile challenges the 'countervailing' marker on grounds that geoengineering could create inadvertent and undesirable side-effects. Even scale, which is fairly pervasive in definitions of geoengineering (Bellamy et al., 2012), is challenged as a criterion by critics who highlight localized interventions, such as soil biochar and roof-top whitewashing.

The term 'geoengineering' is used to refer to a wide assortment of disparate existing and speculative technologies, with different characteristics and implications for society (Betz, 2012; Corner et al., 2013; Hulme, 2014; Robock, 2011). Thus the usefulness of the label has been challenged. Heyward (2013) follows the Royal Society (2009) and advocates disaggregating 'geoengineering', talking instead about solar radiation management (SRM) and carbon dioxide removal (CDR) technologies. The latter Heyward suggests might be better understood as a subset of mitigation, since the aim of CDR is similarly to avoid a given atmospheric greenhouse gas concentration, rather than just an average global temperature increase.

Other attributes used to divide geoengineering technologies into different subclasses include distinctions between encapsulated and unencapsulated technologies, the systems they affect, the scale of their application and whether or not they operate beyond sovereign state boundaries. The Asilomar Scientific Organising Committee (2010) further divided geoengineering proposals into 'remediation' and 'intervention' technologies; perhaps suggesting that some technologies are in effect more advertent, involving embarkation into a new project of techno-mastery, through which humanity not only seeks to reverse human impact, but also pursues a more direct route to a 'planetary thermostat' (Hulme, 2014).

Some geoengineering literature has focused on one technological intervention or another, disaggregating 'geoengineering' further (e.g. Hulme, 2012a). However this distinction is not yet so pronounced in more popular domains where the meta-label 'geoengineering' still dominates (Porter & Hulme, 2013). Further, since many scholars have argued that a geoengineering 'toolkit', comprised of several technologies implemented together, might be needed to respond meaningfully to anthropogenic climate change, the 'geoengineering' label may become less problematic in some theoretical and philosophical research contexts when explored in light of the intentionality that is invoked with the idea of managing the climate in all forms.

In any sense there is clearly limited stability to 'geoengineering' nomenclature (Macnaghten & Szerszynski, 2013; Porter & Hulme, 2013), brightly illuminating the constructed nature of this object of policy analysis. Building on Hajer's (1995) understanding that the definition of

environmental problems is performative in and of itself, in their frame analysis Cairns & Stirling (2014) offered perhaps the most useful conceptualization of geoengineering for the interpretativist social sciences. By avoiding imposing their own *a priori* definition of 'geoengineering', and instead focusing analytical attention on 'geoengineering' as a discursive phenomenon – the bounds of which are continually being negotiated – they left their research open to analyzing the range of ways in which this term may be performed.

2.3 Contested Geoengineering

A number of geoengineering opinion polls and other deliberative methods have been commissioned to assess public knowledge and acceptability of geoengineering research and deployment. Largely focused within the predominantly anglophone countries of the United Kingdom and the United States, studies have typically reported cautious and reluctant, but reasonably open, attitudes to geoengineering research (e.g. Mercer et al., 2011; Parkhill & Pidgeon, 2011; Spence et al., 2010). Similar conclusions have also emerged from geoengineering media content analyses, where newspaper articles surveyed in Porter & Hulme (2013) were typically found to concede that one day geoengineering may be more desirable than the enduring impacts of unmitigated anthropogenic climate change. A widely reported preference for more conventional mitigation options over geoengineering techniques also emerged from this body of research (e.g. Spence et al., 2010). So too did a general preference for carbon dioxide removal methods over solar radiation management (Pidgeon et al., 2012; Spence et al., 2010).

Muddying these conclusions however, is the corresponding finding that the general public tend to have low awareness of what geoengineering actually is (Leiserowitz, 2010; Mercer et al., 2011; Spence et al., 2010). In a 2010 climate change poll Leiserowitz, for example, found only 3% of Americans were able to correctly describe 'geoengineering' (Leiserowitz, 2010). While awareness of geoengineering may be gradually increasing, such unfamiliarity with the term suggests people surveyed in these polls generally did not have pre-existing knowledge or opinions about geoengineering, which raises questions about what exactly these surveys were measuring.

Thus, despite the reported public 'openness' to geoengineering research, Pidgeon et al., (2012) argued geoengineering to have the potential to generate very intense levels of controversy. The appearance of a bipolar factor[2] in Cairns & Stirling's (2014) application of Q-methodology to the study of geoengineering framings among prominent geoengineering actors forms part of the evidence that suggests this hypothesis is being realized and geoengineering is emerging as a highly contested issue.

[2] In Q-methodology bipolar factors are indicative of groups of participants expressing almost opposite attitudes towards geoengineering (see section 7.1.1).

2.3.1 Framing Geoengineering

A small, but growing, literature has analyzed framings of geoengineering, primarily, but not exclusively, within media domains. Frame analysis is a discourse analysis technique (Scheufele, 1999), the origins of which are generally attributed to sociologist Erving Goffman (1974), who asserts that in order to make sense of life experiences, people engage in a process of classifying, organizing and interpreting, or 'framing' these experiences. These "schemata of interpretation" then enable us to "locate, perceive, identify and label" (Goffman, 1974: 21).

Whilst now a heterogeneous technique employed by scholars of diverse theoretical tradition (Benford, 1997), Entman's (1993) work on media framing is often taken as an initial point of entry into frame analysis. Entman (1993: 52) defines framing as "select[ing] some aspects of a perceived reality and mak[ing] them more salient in a communicating text in such a way as to promote a particular problem definition, causal interpretation, moral evaluation, and/or treatment recommendation for the item described". In essence for Entman (1993) frames define problems, diagnose causes, make moral judgements and suggest remedies.

Entman's understanding that framing involves emphasizing certain elements of a topic while downplaying others, is echoed by numerous other scholars (e.g. de Vreese, 2005; Gitlin, 1980; Pan & Kosicki, 1993; Perelman & Olbrechts-Tyteca, 1969; Kwansah-Aidoo, 2005; Dirikx & Gelders, 2010; McCombs et al., 1997). As understood by Perelman & Olbrechts-Tyteca's (1969: 116) "by the very fact of selecting certain elements and presenting them to the audience, their importance and pertinence to the discussion are implied". A frame thus helps reveal what a person feels is important about an issue, making it a useful conceptual tool for exploring the values and priorities being constructed and debated in geoengineering discourse. Review of such framing literatures, and other salient empirical and theoretical literatures related to these frames, therefore usefully summarizes a number of contested dimensions to the 'geoengineering' debate. Notably the geographical bias of existing studies of geoengineering discourse – which have been largely focused on the discourse of anglophone nations in the Northern Hemisphere – will inevitably shape this endeavour (Corner et al., 2012).

2.3.1.1 Geoengineering as a Techno-Fix

Earlier work published in Porter & Hulme (2013) found the debate on geoengineering in the UK print media to be centered thus far on framing geoengineering as a technological innovation and as an issue of risk management. Through an 'innovation' framing, articles offered contested accounts of the leverage that science and technology may or may not offer humans, and their resulting ability to affect, or control, the global climate system. Discussion often centered on feasibility – whether or not humanity has the technical prowess and knowledge to mediate the climate through

geoengineering technologies – and on issues of efficiency and optimization. Reflective of the 'technological fix' framing identified in Scott (2012), and the controllability metaphors in Luokkanen et al. (2013), this frame is strongly allied with the 'managerial' frame identified in Buck (2011) and echoed in Cairns & Stirling (2014); a contested storyline about the need to manage the planet through technology.

Media outputs on geoengineering are often incited by such occurrences as the publication of a journal article or other academic institutional report (Porter, 2011). Geoengineering assessment reports, journal publications and established appraisal criteria therefore unsurprisingly shape and reflect 'techno-fix' media framings. Such debates as the effectiveness, feasibility, controllability and scalability of different technologies, their varying forcing potentials, the rate at which they could be deployed, the comprehensiveness of their response and the complexity of the natural systems that geoengineering interventions hope to affect, have gained particular salience (Nerlich & Jaspal, 2012; Sikka, 2012, c.f. Boyd, 2008a; Morgan & Ricke, 2010; Loukkanen *et al.,* 2013; Royal Society, 2009; Vaughn and Lenton, 2011). Related 'economic' framings (Porter & Hulme, 2013), concerned with issues such as how much technologies cost, who is going to pay for them, their cost efficiency and the way in which they may support national and international economies and industries are at times also closely linked (Bickel & Lane, 2009; Morgan, 2010; Royal Society, 2009).

2.3.1.2 Geoengineering to Respond to a Climate Emergency

Geoengineering necessitated by impending climate catastrophe has emerged as a further dominant framing from numerous geoengineering framing studies (e.g. Anshelm & Hansson, 2014; Bellamy et al., 2012; Buck, 2010; Nerlich & Jaspal, 2012). A last resort reaction to pre-empt a 'climatic emergency', this 'risk' framing (Porter & Hulme, 2013) is often intertwined with alarmist rhetoric of the perils of anthropogenic climate change (c.f. Hamilton, 2013) and with governance narratives of 'political realism' (Anshelm & Hansson, 2014) that describe geoengineering through the metaphor of an 'insurance policy' or a 'Plan B' strategy (Bellamy et al., 2012; Nerlich & Jaspal, 2012; Porter & Hulme, 2013; Scott, 2012).

Reflecting Scholte et al.'s (2013) 'ambivalence' frame, the likelihood, and nature, of harm that geoengineering could cause are under discussion within 'risk' frames. And the dangers of engaging, or not engaging, geoengineering technologies relative to the risks of unmitigated anthropogenic climate change are contested (c.f. Pidgeon et al., 2012). Linking constructions of risk with constructions of techno-optimism and pessimism, literatures which highlight scientific uncertainties and the potential for inadvertent and irreversible regional and global, social, economic and environmental consequences are often invoked in these frames, which may afford different

technologies different risk profiles (Betz, 2012; Rayner et al., 2013; Royal Society, 2009; Vaughan & Lenton, 2011).

'Risk' frames, as identified in Porter & Hulme (2013), are at times further developed through 'Security' (*ibid.*) frames that designate geoengineering as either a threat or a solution, to local, national or international security concerns. Associated storylines of potential political contestation arising from (mis)attribution of unusual weather events to climate control endeavors and of potential and perceived rogue actors, have faced particular attention in recent literatures (e.g. Horton, 2011; Hulme, 2010a; Hulme et al., 2011).

2.3.1.3 Geoengineering as a Series of Moral Challenges

Geoengineering discourse also encounters both powerful 'Morality' and 'Justice' framings (Porter & Hulme, 2013). Ethics literatures raise, for example, questions about who will be the winners and losers of geoengineering (e.g. Jamieson, 1996; Gardiner, 2011a). As Buck (2012a) highlights, such humanitarian principles as the responsibility to protect may form a rationale for deployment of, or resistance to, geoengineering through narratives of promise or peril for vulnerable populations. Questions of geoengineering governance, which tend to be focused on the institutions and political mechanisms through which geoengineering would and should be governed, are likewise often linked with justice questions (Porter & Hulme, 2013). A related narrative to have emerged from recent literature, for example, pertains to the assumption that geoengineering may necessitate inherently undemocratic decision-making, driven by autocratic governance and dependence on top-down expertise (Gardiner, 2011b; Szerszynski et al., 2013).

'Morality' framings make explicit assertions about the relative 'rightness' or 'wrongness' of deploying or not deploying geoengineering technologies (Porter & Hulme, 2013). Narratives that cast geoengineering as an inadequate substitute for emissions reductions appear, for example, through the idea of the 'moral hazard' of geoengineering research; a metaphor introduced in the Royal Society's (2009) assessment report. In the words of Buck (2012a: 255), such a line of reasoning may attest that geoengineering would "allow a 'business as usual' fossil-fuel regime to continue chugging along for the benefit of a small elite", whilst thwarting the required societal reorganization, and propagating a social and economic order that is inherently unsustainable, or unjust (Corner & Pidgeon, 2010; Buck, 2010). Supported by the prevalent narrative of geoengineering research as the start of a 'slippery slope' towards deployment (Gardiner, 2011a; Jamieson, 1996), in such accounts tackling the problem of climate change is clearly not just about halting rising temperatures, but rather also about other social, political and environmental agendas.

Highlighting again the eminence of the 'managerial' frame identified in Buck (2011) and Cairns &

Stirling (2014), debates about the role of human agency and the ethics of deliberate climate modification also take on a formative role in geoengineering discourse. Following literature that suggests the planet to now be within the 'Anthropocene', where humans have become the dominant influence over the Earth's ecosystems (Crutzen, 2002a, 2002b; Steffen et al., 2011a, 2011b; Zalasiewicz et al., 2011), related narratives call for reflection on humanity's moral obligations to the non-human world (Sandler, 2012a) and ask what it might mean for humanity to "make" the climate (c.f. Galarraga & Szerszynski, 2012). As Hulme, (2010b: 270) comments, through this frame we are asked to consider the human role as an "actor in the story of climate, alongside the personal gods of the heavens" (see also Donner, 2011, 2007; Jankovic, 2006).

Again these frames are highly contested. The 'naturalism' storyline identified by Anshelm & Hansson (2014), for example, suggests geoengineering to be a process with natural analogues that could offer the opportunity to redress the disturbed human relationship with the natural world (see also Scott, 2012); thus challenging "messing with nature" narratives identified elsewhere (see also Corner et al., 2013; Porter & Hulme, 2013). Buck (2012a), meanwhile, challenges the 'moral hazard' metaphor, suggesting that geoengineering and its co-benefits could offer transformative opportunities for necessary structural redress. Similarly there have been suggestions that the threat of geoengineering could actually spur action on climate change (Reynolds, 2014; Shepherd, 2009).

2.4 Why We Disagree About Geoengineering

> *"The underlying reasons for the public arguments that flare around climate change… are to do with the different worldviews, beliefs, ideologies and values of different cultures, social constituencies and political interests. These differences will not be altered or reconciled by climate science"*
>
> *(Hulme, 2012b)*

To help synthesise a complex and at times multifarious body of work, many of the geoengineering frames described above – and throughout this chapter – have been summarized in appendix 2.1. These framing literatures clearly make a notable contribution to relating and describing a range of positions on geoengineering, which give precedence to different issues and priorities. And this contribution has been further developed by a range of other theoretical and empirical explorations of geoengineering. Theological reflection in Clingerman (2014), for example, revealed the plausibility of positions on geoengineering from cautious acceptance to outright rejection. Macnaghten & Szerszynski (2013: 468) additionally commented that shared "lifeworld experiences" had some influence over how their focus group participants structured their responses to geoengineering.

Through these literatures multiple, and often competing, understandings of why geoengineering is, or is not, desirable and feasible have emerged; revealing that geoengineering is a debate that goes beyond the surface issues of greenhouse gas concentrations and average global temperatures (see also Hulme, 2014; Szerszyski et al., 2013). Instead, through this work geoengineering can be seen to invoke a discursive arena in which people tell fundamentally different stories about what they think of as common sense in the world and, more normatively, what matters, what is desirable, and equally what should be avoided. In the words of Buck (2010: 2), "geoengineering is a point where cosmologies collide: People who envision the world (and the place of humans within it) in one way, and people who see the world in another way, have emotionally charged conflicts about how to interpret the meaning of geoengineering".

2.4.1 Upper-Case Geoengineering

Appreciating 'geoengineering' as socially constructed reflects a wider and more developed field of research, arguably led by Mike Hulme (e.g. 2009). Seeking to explain "why we disagree about climate change", Hulme argues that understandings of the cognate issue of climate change are culturally, socially, institutionally and historically, as well as idiosyncratically, rooted (Beck, 2012; Dirikx & Gelders, 2010; Hoffman, 2010; Lahsen, 2008). For scholars of this literature, climate change is a debate driven by wider social values, which reflects different relationships with climate, gives precedence to different issues and priorities and reflects different experiences, interests and beliefs (Bravo 2009; Crate & Nuttall, 2008; Donner 2007, 2011; Gifford, 2011; Mortreux & Barnett, 2009). As Boia (2005: 182) surmises, "climate is a massive presence and its parameters constitute one of the essential conditions for the evolution of life and of humanity. However, this axiom provides the basis for an incredible variety of interpretations and scenarios. The imagination thrives on reality but remodels it and invests it with multiple meanings".

To reflect this messier understanding of the phenomenon, Hulme (2009) coined the concept of upper-case Climate Change. Where lower-case climate change describes a positivist reading of the issue "uncomplicated and untainted by ideology" and achieved by 'objective' study using the scientific method (Hulme, 2009: 327), upper-case Climate Change, Hulme explains, is "entangled with and interpreted by the ideologies of the stories that are told about Climate Change and what it signifies". Work on upper-case Climate Change then is interested in the meanings and understandings of climate change in society and has its own wider roots, spanning at the very least the literatures of science and technology studies, sociology of science and human geography. Such work has sought to establish the significance of heuristic, social and cultural ways of life in policy preferences on emerging technologies[3] (see especially Jasanoff, 2010).

[3] The distinction between upper-case and lower-case readings of climate change and geoengineering serves as a useful rhetorical device that "as stylised caricatures of extreme positions… helps to expose the cause of some of our confusions" about climate change and geoengineering. (Hulme, 2009: 328). However as Hulme

This case that has been particularly well argued in literatures on environmental risk assessment. Wynne (1992), for example, seminally illustrated how public understandings of science and environmental risk are shaped by existing attachments to place, identity and belief systems. Meanwhile other research has argued that people of opposing cultural outlooks – as measured through discursive as well as psychometric accounts of such notions as 'values', 'beliefs' and 'worldviews' – polarize on various assessments of environmental and technological risk (Douglas & Wildavsky, 1983; Finucane, 2002; Nisbet, 2005; Nisbet & Goidel, 2007; Peters & Slovic, 1996). Indeed a collection of empirical work has argued such belief systems to be better predictors of perceptions of environmental problems than socio-demographic variables (e.g. Dietz et al., 2007; Jaeger el al., 1993; Samdahl & Robertson, 1989 cited in Thompson & Raynor, 1998; Shwom et al., 2010).

2.4.1.1 The 'Hall of Mirrors'

Work in the field of indigenous rights and natural resource management has powerfully illustrated some of the consequences of a lower-case interpretation of environmental management, where value is understood as self-evident and western scientism holds supreme authority. Attending to the plural and messy normative dimensions of the relationship between knowledge, values and action (see Collingridge & Reeve, 1986; Stirling, 2010), Howitt (2001), Suchet (2002) and Rose (1999), for example, argue that politically powerful agents and authorities in Australia may practice natural resource management as if it were a universally supported knowledge. This, they argue, is because internal processes of knowledge validation position these actors within an epistemological circular argument, in which the solipsistic assumption that their Eurocentric knowledges are universal, self-reference to 'objectivity' and established hegemony legitimate each other (e.g. Howitt, 2001).

Deborah Bird Rose (1999: 178) developed a powerful metaphor drawing on an image of the 'hall of mirrors', for how actors develop such self-referential circular arguments to validate their knowledge: "The self sets itself within a hall of mirrors; it mistakes it's reflection for the world, sees it's own reflection endlessly, talks endlessly to itself, and, not surprisingly, finds continual verification of itself and its world view". By assuming that one type of knowledge – in this case a dominant Eurocentric knowledge of natural resource management based on the paradigm of Western scientism – is the only valid knowledge of natural resource management, authorities can justifiably and unproblematically assert management concepts and practices appropriate to this one set of knowledges. Other knowledges are thus silenced, ignored or devalued.

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notes, this distinction between climate change as a physical phenomena and between 'Climate Change' as an idea is ambiguous. There has therefore been no attempt to consistently apply this casing distinction elsewhere in the thesis, although it is occasionally employed for emphasis.

Institutions within the hall of mirrors can then continue to unproblematically assert their dominance. All ways of seeing, doing and knowing resource management reflect back to them and are verified by having only their own terms of reference. All the while the process is silent, hidden and therefore closed to being challenged. As Rose continues, "this is monologue masquerading as conversation, masturbation posing as productive interaction; it is a narcissism so profound that it purports to provide a universal knowledge when in fact its violent erasures are universalizing its own singular and powerful isolation" (ibid).

In this setting the implication for Australian natural resource management is that post-colonial power structures are perpetuated in what Rose (1996: 6) has labelled "deep-colonizing", while indigenous knowledge systems, often not understood by the dominant Eurocentric model, are subjugated to a lesser order within the governing framework. A related case has however been made in the context of climate change knowledge, where scholars have challenged the pervasive assumption that we could reach more certain and prescriptive knowledge on climate change by integrating knowledges from different actors, scales and epistemological outlooks to form consensus.

This case has been made most persuasively through examination of the Intergovernmental Panel on Climate Change (IPCC) where, in the pursuit of more certain and prescriptive knowledge of climate change, the organisation aims to speak with "one voice", and, through the integration of knowledges from different actors, scales and disciplines, realize global knowledge "*convergence* and *uniformity"* (Beck, 2012: 3)[4]. Yet as has been argued in the case of Australian natural resource management, any claim to one "unanimous", "comprehensive", "rational", "correct" or otherwise "superior" knowledge of climate change would be an inherently political act, only achievable within the hall of mirrors, where the multiplicity of competing worldviews, values and belief systems has been silenced. Thus just as indigenous knowledge has been seen as colonized in Australian natural resource management strategies, it has been argued that the realities that are privileged and preserved by the IPCC are those which have been able to gain and retain power.

In its pursuit of "value-free science" Beck, (2012) argues for example, that the IPCC adopts a linear model of expertise on climate science that, while aggrandizing positivist science, offers limited space to interpretative and place based knowledge (e.g. Bjurström & Polk, 2011; Hulme & Mahony,

[4] Scientific consensus about anthropogenic climate change so as to inform policy makers internationally, was a key premise of the original 1988 IPCC mandate (Hulme, 2010c). But as Hulme (see Porter, 2012) has documented, this is not a unique ambition of the IPCC and it has also emerged within other global environmental forums. Calls for consensus were explicitly pronounced, for example, in the State of the Planet Declaration arising from the recent Planet Under Pressure Conference in London (*i.bid*). As part of a "*move to effective Earth-systems governance*" this declaration called for knowledge to be *"integrate[d] across existing research programmes and disciplines, across all domains of research as well as local knowledge systems, across the North and South"* (Planet Under Pressure, 2012).

2010; Ford et al., 2011). In its task of synthesizing knowledge, it validates and legitimates certain types of scientific evidence through its very selection of sources (Beck, 2012). Its literature is heavily biased towards the natural sciences, with social science content derived largely from economics (Bjurström & Polk, 2011; Carey et al., 2014). Further its literatures have been found to reflect geo-political power imbalances. Hulme & Mahony, (2010), for example, highlight the limited participation of experts from developing countries in the drafting of the reports. While Ford et al., (2011) suggest indigenous knowledge is a particular casualty of the IPCC's epistemological framing. Alongside the limited representation of Indigenous populations and their organizations in the IPCC process, traditional ecological knowledge of climate change, embedded in myths, traditions and experience, is not always easily understood in a context of positivist science.

2.4.1.2 Post-Normal Geoengineering

Together this scholarship builds on the well-rehearsed thesis from science and technology studies that challenges the post-enlightenment idea that science operates in a vacuum: Understanding science instead to be culturally and socially constructed and situated (Inokoba, 2010; Jasanoff, 2010; Proctor, 1998). Allowing knowledge to be presented as an ultimate truth, while casting other discourses as irrational, is therefore held to be profoundly undemocratic (Kearnes et al., 2006; Stengers, 2010a, 2010b; Wynne, 1992). Upper-case Geoengineering accordingly demands a 'post-normal' understanding of science (Funtowicz & Ravertz, 1993).

Advanced by Funtowicz & Ravertz (1993: 744) as a model for decision-making around issues "where facts are uncertain, values in dispute, stakes high and decisions urgent", in post-normal science the necessarily subjective and value-laden nature of geoengineering preferences is accommodated, and geoengineering is understood to be 'discursive' (Hajer, 1995). Since no one, objectively 'correct', policy conclusion is sought, in the words of Hulme (2007), scientists "must trade (normal) truth for influence". Moreover, in upper-case Geoengineering, scientific literacy can no longer be seen as the driving force of public decision-making rationales (c.f. Allum et al., 2008; Dryzek, 2000; Jasanoff, 2005; Nisbet & Goidel, 2007; Oreskes, 2004; Shwom et al., 2010).

Post-normal science calls for more holistic ways of exploring environmental issues, which recognise humans and their values as integral parts of natural systems and of the management of these systems. The preexisting frameworks, prior knowledge and underlying differences in value and paradigm predisposition, through which public perceptions of science are interpreted, are therefore embraced (Beck, 2012; Jasanoff, 2010; Thompson & Raynor, 1998; Wynne, 1992). And reflective of that which has been described as a 'cosmopolitan' approach (Beck, 2012; Hulme, 2010b, 2010c; Jasanoff, 2010), now open to alternative problem framings, a wider range of ontological, epistemological and axiological perspectives make space for contestation and normalized reflection

about geoengineering (c.f. Beck, 2012; McCarthy, 2003). Indeed, as will be discussed in section 2.6 below, this pluralism is understood to be an opportunity for mutual learning and innovation.

2.5 Closing Down the Geoengineering Debate

From this literature, drawn together above to support an upper-case interpretation of Geoengineering, a case for an open and inclusive approach to exploring the geoengineering debate is starting to emerge. Before this reasoning is developed however, such an assertion begs the question of, how plural is the current debate on geoengineering? And whose voices are framing geoengineering at present?

2.5.1 The "Geoclique"

Environmental, social and political issues are mediated through, and reflected by, filters and templates that are bequeathed to us by all the knowledge-producing domains of societies; media, political, legal and economic systems offer but a few, especially visible, examples. Knowledges of geoengineering are produced, revised and played out within these multiple domains, and condition the environment in which geoengineering is emerging (see Luhmann, 1995; Wagner, 1996). The mass media is just one domain in which knowledges and ideologies of geoengineering and their associated value systems are produced, revised and played out. But it is an arena of multifaceted discourse and the domain in which most framing studies have focused their attention (Porter & Hulme, 2013).

That media outlets are fundamental in the shaping of cultural politics, public opinion and understandings of global issues is a general consensus in the literature (Beck, 1992; Wilson, 1995; Gamson, 1988; Bell, 1994; McComas & Shanahan, 1999; Slovic, 2000); although the exact nature of this influence is more contested. Media discourse is susceptible to the exercise of hegemony and different knowledges seek legitimacy in the public domain. Indeed actors may 'court' the media to frame and amplify their views on an issue (Pan & Kosicki, 1993; Pertschuk & Schaetzel, 1989). Buck (2013a: 174) explains the implications of this relationship when she writes, "those who are speaking have the power to simplify complexity; it is in some crude sense those who have voice that have the power, the authority, the ability to author reality".

In an earlier UK newspaper content analysis, Porter & Hulme (2013) suggested a small number of actors are disproportionately being given authority to speak on and frame geoengineering in the UK print media. And this paper was far from the first to make this case. In his popular science book 'Hack the Planet', Eli Kintisch (2010) coined the metaphor, 'the Geoclique', to characterize the elite group of predominantly North American natural scientists working in this field of

research, that he argued were dominating geoengineering knowledge production and framing social discourse. Hamilton (2011a) later made similar assertions[5].

In discursive fora, the 'Geoclique' appellation has gained salience through the presumption that people of shared disciplinary backgrounds may have various shared ontological, epistemological and axiological affinities (Lahsen, 2008). Developing such reasoning, Hamilton (2011a) argues this small group of atmospheric scientists bring a markedly industrial, even Promethian, perspective to the debate, and represent a kind of crescendo in Enlightenment thinking. Hamilton (2011a) writes, "they have the kind of faith in humanity's ability to overcome threats and master the environment that defined the science-as-saviour culture of the United States in the post-war decades. While they are worried about the damage being done to the environment, they cannot see any intrinsic reason why, if we have the means, we would not take control of the planet as a whole".

The idea that the geoengineering debate has epistemologically privileged and reflected a singular and enduring perspective from a small clique of natural scientists remains contested. Diversity was a defining characteristic even within Kintisch's original conceptualization of the 'Geoclique'. Here Kintich described David Keith's analogy of geoengineering scientists occupying a blue team and a red team, which concentrate their research efforts on trying to prove potential geoengineering techniques could be a useful and constructive response to anthropogenic climate change, or that they couldn't, respectively (Kintisch, 2010: 8-9). Studies have also observed a more recent 'opening up' of newspaper discourse, which could imply a wider range of actors are shaping the debate[6].

Empirical examinations of the term do nevertheless reflect Hamilton's (2011a) claim that a small subset of actors have made themselves the 'go-to-guys' on geoengineering. Buck applies the neologism in a fairly uncomplicated way to the most cited geoengineering scientists in her sample of English language articles from major world newspapers and an online media sample published between 1990 and 2010. 70% of assertions on geoengineering identified within the corpus she finds were made by natural scientists and engineers. But, more revealing still, about 36% of assertions came from only nine scientists[7].

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[5] While some scientists like David Keith and Ken Caldeira are positioned as figureheads of the Geoclique and named explicitly, both Kintisch and Hamilton only explore the membership and validity of the 'Geoclique' metaphor rhetorically.

[6] Suggesting that geoengineering is undergoing a transition into more mainstream discourse, Porter & Hulme (2013) found that an increasing number of the events deemed 'newsworthy' enough to trigger journalistic accounts of geoengineering have arisen from more popular domains, such as from climate change politics and popular science writing. Scholte et al.'s (2013) recent framing study of English-language newspaper discourse also argued that the geoengineering debate has actually been 'opening up' (c.f. Stirling, 2008) to a wider range of perspectives. This 'opening up' was evidenced through a recorded decline in the presence of overly deterministic frames, the emergence of frames related to sociopolitical issues and an overall more balanced distribution of the various frames.

[7] David Keith and Ken Caldeira alone were responsible for 15% of the assertions (Buck, 2013a).

A number of the scientists Buck found to be influential in shaping the geoengineering debate are European, representing a shift from the distinctly North American profile that the 'Geoclique' was afforded by Kintisch (2010). However the typical profile of a prominent voice in geoengineering discourse nevertheless remained that of a middle aged, white, male, anglophone natural scientist from the United States or the United Kingdom (Buck, 2013a). This modest departure from Kintisch's original characterization of the term does not therefore prevent Buck from broadly implying the terms ongoing utility. The Global South and indigenous peoples have been largely excluded from geoengineering research and deliberative social science work on perceptions of geoengineering[8] (Bellamy et al., 2013; Belter & Seidel, 2013; Whyte, 2012) and Buck found women and the developing world to be particularly voiceless in geoengineering discourse. These findings suggest the existing debate on geoengineering is deeply gendered as well as ethnically, culturally and geographically biased.

2.5.2 A Rhetorical Closing Down

As well as concern about the limited number of actors being heard on geoengineering, there is evidence in the literature to suggest the discursive strategies of these actors may powerfully structure their own rhetorical 'closing down' of the debate, leaving little space for alternative perspectives (c.f. Stirling, 2008). Frames exclude those elements of an issue that do not fit within their own narrative, meaning alternative perspectives are silenced. That similar frames have been observed and related in multiple discourse analyses itself suggests the debate is already converging around a certain set of ideas about what it would mean to geoengineer, or not to geoengineer, the climate system. And at times, frames observed in media and policy domains have themselves been described as forcing closure on the debate by constructing a storyline of geoengineering as common-sense, necessary and practical.

Using critical discourse analysis to unpack some of the discursive strategies employed by a number of significant geoengineering advocates, Sikka (2012) argues that through the discursive frames of 'scientific neutrality', 'technological determinism', 'philosophical exceptionalism' and of 'market-driven solutions', geoengineering has been constructed as common-sense, necessary and practical. Nerlich & Jaspal (2012) similarly found 'climate emergency' framings limit and shape the geoengineering debate by suggesting that geoengineering is the only option to avoid 'planetary catastrophe'. Buck (2013a), Gardiner (2010) and Szerszynski & Galarraga (2013) have made similar arguments around how frames of 'effectiveness' define appraisal parameters, implicitly establishing the boundaries of "legitimate" science, and casting it as the jurisdiction of experts.

[8] Winickoff et al., (2015) forms the notable exception known to the author.

That policy discourse has also congregated around discussion of a small number of geoengineering technologies has further aggravated claims that the geoengineering debate is experiencing a premature 'closing down' (Stirling, 2008). So too has the observation that frameworks for assessing geoengineering have, until recently, considered only limited technocratic, risk-based metrics (Bellamy et al., 2012). Such appraisal techniques, Buck (2013a) argues, leave out important human, social and political dimensions to appraisal processes and consider geoengineering in isolation of other climate change responses.

2.6 Substantive, Instrumental and Normative Rationales for Participation

So why then does it matter if the geoengineering debate is 'closing down' around a small set of voices, technologies and framings? Such a question is perhaps best answered through participation literatures, where Fiorino (1990), Stirling (2010) and Chilvers, (2009), all highlight ***substantive, instrumental and normative*** rationales for avoiding top-down technological pathways that reflect only the needs and values of a restricted social group.

Substantive rationales for an 'opening up' of the geoengineering debate recognise that pluralism in contemporary discussions of geoengineering can prevent options being prematurely ruled out and lead to new ways of tackling the problem (c.f. Crompton, 2008; Jasanoff, 2010). Substantive rationales also argue, for example, that facilitating a better understanding of alternative perspectives can enable constructive dialogue, and that diverse perspectives can promote and enhance our overall capacity for innovation, produce more robust knowledge and reduce the risks associated with innovation (Hedlund-de Witt & Hedlund-de Witt, 2015, *in press*; Wynne, 1992; Schuurbiers et al., 2007; Soetaert & Vandamme, 2006; UNESCO, 2002). Fioriono (1990), for example, argues that non-experts can identify issues and solutions that experts may not pick up on.

Premised on the assumption that public acceptance of new technologies is fundamental to their credibility and success, ***instrumental*** rationales for wider participation in geoengineering debates suggest participation is fundamental to public trust and support for an innovation (Chilvers, 2009). The hostile reception and limited adoption of previous scientific innovations, such as the introduction of genetically modified foods to European markets, highlight the need for technologies to be publically sanctioned (Felt et al., 2007; Hinchliffe et al., 2009; Soetaert & Vandamme, 2006). Such a rationale found particular salience in the geoengineering debate when the Stratospheric Particle Injection for Climate Engineering (SPICE) project field trial was discontinued partly due to insufficient public consultation. This case powerfully illustrates one of the problems of merely deferring to expert opinion (Macnaghten & Owen, 2011).

Normative rationales for participation are concerned with democracy in decision-making. Founded on the assumption that "as an ethical presupposition… citizens are the best judge of their own interests" (Fiorino, 1990: 227), at their heart normative arguments for participation in geoengineering challenge the right of a few to effectively "author reality" on this issue of global consequence (Buck, 2013a). These rationales play on principles of social justice and equity and attest "participation is the *right* thing to do", that "citizens have the *right* to influence decisions that affect their lives" (Chilvers, 2009: 402).

With rising acceptance of the "post-normal" nature of environmental issues like climate change, there is increasing call for researchers to make their own normative positions and philosophical assumptions clear. Indeed Onwuegbuzie & Collins, (2010) list such transparency among their quality criteria for qualitative research. A timely contribution to this chapter is therefore acknowledgement of my own commitment to normative geoengineering participation rationales, which until now has been only implicit. A short account of the basis of this commitment will now follow.

2.6.1 Why Care About Democracy in Geoengineering Decision-Making?

That we live in a vastly unequal world seems evident. This inequality is pervasive. It stretches into every aspect of life and it is perpetuated by, and derived from, persistent and entrenched power structures operating at all levels of society. Most salient to the current discussion, and as argued by Stirling (2010), the adverse consequences of technological innovations tend to fall disproportionately on the most marginalized members of society who experience least wealth, privilege and influence. "Pre-existing social conditions of marginality exacerbate vulnerability to even the most general of the unforeseen, unintended and contested consequences of technological commitments", Stirling (2010: 5) writes.

This inequality manifests in participation in governance and decision-making. Possessing further tools of influence and persuasion, powerful actors and institutions are able to project their own imaginaries into social discourse and decision-making. Thus more privileged interests are able to shape the technological pathways that protect their own interests (Felt, Wynne et al., 2007; Foucault, 2000; Gramsci in Smith & Hoare, 1971; Howitt, 2001; Jasanoff, 2005). Stirling (2010: 5) surmises the consequence of this hierarchy explaining, "not only are the poor vulnerable to the technological choices of the rich, but the technological choices that might most favor the interests of the poor are also disproportionately liable to being foreclosed".

For any technological development scenario these trends are troubling. However for this researcher, nowhere is this dynamic more problematic than in the case of geoengineering. Climate

change is globally threatening, and the decision to geoengineer, or not to geoengineer, the climate is a decision that could affect everyone, and everything, that inhabits the Earth and experiences different facets of the global climate (Hulme, 2014). That those most vulnerable to the impacts of this decision are also those who have contributed least to causing climate change presents a further ethical dilemma (Hartzell-Nichols, 2011). Furthermore, as will be explored especially in section 2.8.4.2, for some the intended scale of geoengineering is such that geoengineering represents an unprecedented intervention into management of the natural world, which fundamentally changes what it means to be human (Clingerman, 2014; Galarraga & Szerszynski, 2012; Preston, 2012).

In a domain with all this to play for, that those with most at stake could be excluded from determining the vision and priorities through which climate change management and geoengineering research proceeds, seems problematic. That public funds may be invested in research and development of geoengineering only exacerbates this ethical quandary. As argued by Howitt et al. (2012: 48) global environmental challenges like climate change "should be addressed as opportunities for decolonization rather than continuing to impose poorly conceptualised and badly implemented strategies that continue to multiply the miseries" visited upon disempowered groups (Howitt et al., 2012: 48).

2.7 Existing Geoengineering Public Engagement Research

For many of the reasons outlined above, participation – and notably 'upstream' participation (Kearnes et al., 2006; Wilsdon & Willis, 2004) – is now typically considered essential to the quest for sustainability in science-policy processes (Chilvers, 2009; Owens. 2000). Thus these rationales have already been widely rehearsed in geoengineering literatures (Carr et al., 2013; Hinchliffe et al., 2009; Whyte, 2012). The Royal Society (2009) for example proclaimed "public dialogue, engagement and research to explore public and civil society attitudes, concerns and uncertainties should therefore be a central part of any future programmes of work on geoengineering". Public participation also forms the basis of one of the 'Oxford Principles'; an influential set of proposed guiding principles for the governance of geoengineering research (Rayner et al., 2013).

Within the growing literature on public perceptions, attitudes and knowledges of geoengineering, existing social science research has at times developed participation in a fairly restrictive way using, for example, closed-ended poll and survey methods (Carr et al., 2012; Leiserowitz, 2010; Mercer et al., 2011; Spence et al., 2010). Such an approach Kearnes et al. (2006) note, may compel respondents to adopt 'attitudes' towards geoengineering technologies, but may offer limited insights into the dynamics that have shaped these attitudes.

More open, deliberative methods, meanwhile, have sought to establish what *informed* public opinion on geoengineering may look like and have begun to identify conditions under which geoengineering may be more or less acceptable to publics (Bellamy, et al., 2014, 2013; Macnaghten & Szerszynski, 2013; Parkhill & Pidgeon, 2011; Pidgeon et al., 2013). From this literature a picture is also beginning to emerge about which types of technologies are likely to be considered more or less acceptable in the context of more conventional mitigation techniques (Bellamy et al., 2014).

A smaller body of work has begun trying to explain the difference in geoengineering policy preferences and exploring the forms of reasoning through which people may construct perceptions of geoengineering. As part of research on perceptions of abrupt climate change, Bellamy & Hulme (2011) used Cultural Theory to interpret how their study participants made sense of geoengineering in the context of other climate policy options. This research suggested that those expressing psychometrically attributed 'hierarchist' worldviews, that placed more faith in institutions and governments working within the market, were more open to the idea of geoengineering deployment than those expressing a more 'egalitarian' orientation.

Cairns & Stirling (2014) subsequently used Q-Methodology to begin unraveling disparate understandings of geoengineering among influential geoengineering actors from diverse disciplinary backgrounds and sectors. The relative homogeneity of this expert, rather than public, group will have likely constrained the outcomes of this research (McLaren, *in preparation*). But even within this somewhat discrete group of actors Cairns and Stirling described a 'framing gulf' among what emerged as a set of fairly stabilized discourses[9]. The authors were then able to tease out some of the contested dimensions to the fundamentally different accounts of geoengineering that were captured in the emergent Q-study factors.

While concern about the potential consequences of anthropogenic climate change was at the heart of all of the recorded discourses, the factors in Cairns & Stirling revealed diverse problem definitions that constructed conflicting utopian and dystopian futures. Disputed dimensions to the frames included the capability or fallibility of human agency, and consequently the feasibility of geoengineering. Different accounts of risk and the role and potential of science and research further featured in the frames. And the factors were situated within a deeper political context, where political leanings could be seen interacting with governance preferences and concerns. The role of governments, commercial interests and publics were contested for example, and diverse regulatory requirements were espoused. Preferences for different types of technological solution

[9] Cairns & Stirling's (2014) analysis revealed four dominant framings of geoengineering which they labelled: "At the very least we need more research", "We are the planetary maintenance engineers", "Geoengineering is a political project" and "Lets focus on carbon".

emerged from these frames and prescriptions for investment were also described differently across the factors.

2.7.1 "Messing with Nature"

Corner et al., (2013) conducted a series of four micro-deliberative workshops on geoengineering across the UK with participants from diverse socio-demographic backgrounds (see also Pidgeon et al., 2013). After framing geoengineering as neutrally as possible (following Corner et al., 2011) and engaging with a wide range of perspectives on geoengineering and climate change, the researchers identified the contested narrative of "messing with nature" to play an important anchoring, organising and bridging role in participants' deliberations. What remains of this chapter will now pick up on the 'messing with nature' theme identified in Corner et al. (2013) and emerging empirical and theoretical literatures that have begun exposing a number of discordant interpretations about geoengineering inter alia the meaning of nature, the meaning of the human condition and the changing and desirable relationship between humans and nature, will be reviewed.

By positioning humans and their values and preferences at the heart of their analysis, Corner et al., (2013) make some important analytical headway in comprehending the significance of debate and disagreement surrounding the "messing with nature" storyline. This chapter will nevertheless conclude by making a case for further research to develop understanding of how constructions of 'nature' and 'human agency' may be performed in geoengineering discourse.

2.8 Exploring Constructions of 'Nature' and 'Human Agency' in Geoengineering Discourse

2.8.1 Naturalness

The perceived "naturalness" of emerging technologies has long been argued to be a determinant logic of their public acceptability (Sjöberg, 2004; Slovic, 2000). Thus by the time Corner et al. (2013) suggested "messing with nature" to be a formative logic in their participants' deliberations on geoengineering, a range of other literatures had suggested the perceived 'naturalness' of geoengineering technologies to be influential in their acceptability. Ray (2010) had even gone so far as to suggest 'naturalness' as a criteria against which 'geoengineering' proposals could be defined.

A 2010 study by the UK Natural Environment Research Council was one of the first public consultations to explicitly highlight the importance of 'naturalness' in geoengineering meaning-making (Ipsos-MORI, 2010). This study reported that participants offered more support to geoengineering proposals that they perceived to be more 'natural', or to work with 'natural processes'. Large-scale afforestation was the preferred geoengineering option among study participants, they concluded, because participants considered it to be working in greatest "harmony

with the planet" (Ipsos-MORI, 2010: 32). 'Nature is good, therefore interfering with it is bad' was the basic proposition of this logic (Corner et al., 2013).

Corner et al., (2011) however, cautioned against a simplistic interpretation of 'naturalness' in this *'Experiment Earth'* dialogue. While not excluding the potential power of the 'naturalness' heuristic, the authors suggested that accounts of 'naturalness' had been inadvertently distorted by the instrumental framing conditions of the research. They suggested the idea that some technologies were more 'natural' than others had been introduced to participants, and thus was mobilized by, the research facilitators (see also McLaren, *in preparation*).

That the perceived 'naturalness' of geoengineering technologies may be significant to public perceptions of geoengineering has, however, emerged in a number of subsequent consultations that have taken care to avoid replicating the framing mistakes identified in the *Experiment Earth* dialogue (Bellamy et al., 2013; Macnaghten & Szerszynski, 2013; Parkhill & Pidgeon, 2011; Pidgeon et al., 2012). Indeed in their international survey of public perceptions of solar radiation management, Carr et al., (2012) identified "messing with nature" and "playing God" to be among the most salient ethical concerns of respondents. As Carr et al., (2012: 176) surmise, here the central concern again appeared to be, "whether humans have a 'right' to 'mess about' with the natural world and whether it is appropriate for us to shape the earth's climatic systems in accord with human interests". Thus, through such studies discussion of humanity's impact on nature, and the potential for geoengineering to fundamentally reconfigure the relationship between humans and the world we inhabit, has been stimulated.

Parkhill & Pidgeon (2011) challenged the effectiveness of 'naturalism' framings, suggesting previous debates such as genetic modification made participants in their focus groups skeptical about pronouncements that discuss which technologies are, and which are not, natural. Nevertheless Anshelm & Hansson (2014) found 'naturalism' framings to be employed widely in post-2011 geoengineering media advocacy discourse. This finding is perhaps reflected in Scholte et al., (2013) who also found pronouncements constructing the climate as 'natural', and as something with which humans should not 'tinker' or 'fiddle', to be pervasive in their corpus of English-language newspaper articles.

By developing the first in-depth examination of how public views on geoengineering are shaped by deeper interpretations about the natural world and the human relationship with nature, Corner et al. (2013) revealed a more nuanced range of narratives about the relationship between geoengineering and nature than had been captured in previous empirical research. Complicating the 'naturalness' heuristic, this work reported that, while UK participants generally agreed that 'interfering' with

nature was inherent to geoengineering, perhaps due in part to the remedial ambitions of geoengineering articulated in the 'Plan B' metaphor, there was no consensus among research participants as to whether or not this was a good thing. Instead, Corner et al. report finding almost every dimension of the relationship between geoengineering and nature to be contested within the discourse of their participant groups.

2.8.2 The Human-Nature Relationship as an Underlying Logic to Geoengineering Frame Construction

Corner et al.'s (2013) proposition of the importance of underlying assumptions of the human-nature relationship to perceptions of geoengineering, is not new. In 1974 Robert Fleagle and colleagues wrote of weather modification, "even small efforts to modify weather in specific and limited ways evoke responses which are linked to a vast sounding board resonating with the overtones of man's basic attitudes toward natural events… The layman, having heard widely varying claims [about weather modification], has little basis for discriminating judgment. One man automatically believes reports of success, as perhaps in Stone Age times he would have believed prediction of the medicine man. Another distrusts and resents all efforts to tamper with the weather, as perhaps in an earlier epoch he would have felt rain dances a presumptuous affront to the ruling deity" (Fleagle et al., 1974: 5).

While exploring how issue frames in the UK print media amplify different priorities and values, Porter & Hulme (2013) also argued that accounts of the nature-human relationship emerged as particularly interesting features of frame construction[10]. 'Nature', while not always immediately apparent in the discourse, Olwig (1996, 87) finds is 'a ghost that is rarely visible under its own name'. And, under closer examination, Porter & Hulme argued the framings generated in their research drew on a long history of debate about the relationship between nature and humans, invoking different philosophies, myths and theories of nature. Different narratives within the framings were said to carry with them, for example, different assumptions about the meaning and value of nature; the extent to which human systems are vulnerable to the effects of nature; the extent to which humans have the capacity and knowledge to be able to influence nature; the extent to which exerting such influence is desirable and the extent to which geoengineering interventions may aid or threaten 'nature' and the natural.

Nerlich & Jaspal (2012)'s work adds to the body of empirical literature that finds geoengineering narratives to embody and condense diverse beliefs about nature and human agency: Three dominant metaphors identified within media reporting of geoengineering – *the planet is a machine, the planet is a body, the planet is a patient* – construct different conceptions of the role and state of the

[10] Notably the authors were cognisant that this analysis evolved from a process reflective of Blumer's (1954) 'sensitizing concept'

Earth system and thus construct different boundaries within which to interpret the role of geoengineering. Contested narratives about the nature of the Earth system, the human condition and the possibilities and remit of human agency can similarly be traced through deeper examination of the frames explored, for example, in section 2.3.1 of this thesis.

2.8.3 The Constructed Nature of 'Nature'

Collectively these studies demonstrate that nature too is an inescapably and profoundly social construction (c.f. Hansen, 2006). As Mary Douglas (2003[1982]: 7) wrote, "there is nothing natural about the perception of nature". Across time and space nature has *always* been a major subject on the social agenda Castree (2005) attests, but the concept of nature has never been static. Indeed the observation that the very terminology of 'nature' is deeply ambiguous, led literary critic Raymond Williams (1983: 219) to argue that '"nature' is perhaps the most complex word in the [English] language". An 'upper-case' interpretation of 'Nature' too is therefore essential (c.f. Hulme, 2009, see section 2.4.1)[11].

Offering some theoretical transparency to the concept of nature, Castree (2005: 8) identifies three common ways of understanding nature, which Porter & Hulme (2013) found to each be visible within their corpus of newspaper geoengineering discourse. Closely echoing earlier work in Williams (1983), for Castree nature may be used to refer to (1) 'the non-human world', (2) 'the essence of something', illustrated by the saying "it's in their nature" offered in explanation of certain characteristics of a person or non-human species, or (3) 'an inherent force' which directs the order of things, exemplified for example in a view of nature as a self-regulating system, where a transcendent, God-like power is implied.

While at first glance humans may *appear* excluded from the first use of the nature nomenclature, their role is explicitly integral to, and negotiated within, the latter two conceptions the term. Through these definitions Hansen (2006) suggests nature may be represented as 1) 'good' and 'pure', as conveyed through such narratives as a nurturing, balanced and harmonious 'Mother Nature'; a force best left to its own devices. 2) 'vulnerable' and 'threatened', by man's tinkering. 3) A 'threat' itself; a powerful, or even vengeful force, not to be reckoned with. 4) 'Imperfect' and 5) a 'challenge'; narratives which may be combined to signify a nature that could be developed and improved upon, should scientific entities rise to the occasion.

Culturally and cognitively fabricated, specific and variable, different understandings of nature, and the human place within it, have been particularly convincing at different times and in different contexts (Boia, 2005; Castree, 2005; Cronin, 1996; Simmons, 1993). Of particular salience to this

[11] As discussed in footnote 3 this casing distinction has not been consistently implemented within this thesis, although it is occasionally employed for emphasis

thesis is that prevailing constructions of nature have similarly tempered narratives of weather and climate. For much of human history the goings on of nature, weather and climate have been largely attributed to Gods and other higher forces (Dampier, 1971[1929]; Donner, 2011, 2007; Inokoba, 2010). And for millennia a theistic explanation for nature, humanity and indeed for almost all of social reality, prevailed[12]. "That is, all explanation of social reality was traced to divine source" (Inokoba et al., 2010: 26). Thus Donner (2007: 232) writes, "the notion that humans can strongly influence or be in control of the climate counters thousands of years of religious philosophy and existing traditional belief systems worldwide".

Following such philosophical traditions as those of Rene Descartes and Francis Bacon, however, during the Enlightenment, in 17th and 18th century Europe a God-centered world became mediated by science and reason, as the new "valid" mode of explaining Nature's processes (Boia, 2005, Taylor, 1989). As empiricism developed universalist laws, technological advances progressed with increasing sophistication and science became labelled the foundation of all rational thought, the idea of nature as mysterious and un-knowable was often found yielding to a more mechanistic cognition. Far from the determinism of former paradigms, scientism followed that, if rules in nature could be observed, they could possibly be harnessed. Thus, arguably marking the beginning of the ontological 'Anthropocene' (Crutzen, 2002a, 2002b; Steffen et al., 2011a, 2011b; Zalasiewicz et al., 2011), the human potential to influence nature had entered the human consciousness with vigor. Summarized by Lin (2011: 28), in Baconian thinking "it was not enough to know and to explore, man had to conquer and subdue nature". Such logic continued that it was perhaps only time that stood between man being completely free of the influence of nature, and being able to control it 'at will' (Boia, 2005; Robida, 1982).

Classical enlightenment thinking has been argued to largely dominate modern consciousness in much of the Western world, sanctioning wide-spread human use of natural resources to meet the demands of the market (Pirages and Ehrlich, 1974). Indeed, geoengineering technologies that seek for example to deliberately manipulate global temperatures through modifying solar radiation and thus that effectively pursue direct control over global climate, have often been linked with such enlightenment philosophy as human mastery. Ideas of mastery have been tied to the notion of a climate utopia and the hope that physical climates could be fashioned so as to match the needs and desires of the human imagination (Meyer 2002). Thus, for some, the idea of such geoengineering proposals as solar radiation management imply fundamentally different ways of relating to climate to that recorded in contexts where the performance of climate is believed to be in divine control, or even to reveal divine moral judgment (e.g. Donner 2007).

[12] At times this logic has been extended to incorporate the idea that humanity itself is controlled by these natural forces of divine origin, thus offering a natural interpretation of human diversity (Montesquieu in Boia, 2005, see also Livingstone, 2010)

In more recent years, ideologies of infinite growth, mass production and human exceptionalism have been visibly challenged again in Eurocentric social discourse which has given way to alternative forms of knowing and called for a re-focusing on the aesthetic and spiritual values of nature (Hedlund-de Witt, 2013a; Taylor, 2010). Described variously through such labels as "new age", "back to nature" and "romantic" accounts of the natural world, ideas of interconnectedness, mutual-dependence and nature-human hybrids, 'limits to growth' rhetoric (Meadows et al., 1972), concerns about environmental degradation and challenges to the right of humans to dominate and exploit the rest of nature, have all found renewed prominence (Soper, 1996).

For Taylor (1989: 384) this sensibility, which may be "open to nature within us and without us" and may challenge ideas of a dualism between humanity and an objectified universe, represents a revival of "a crucial part of the conceptual armory in which Romanticism arose and conquered European culture and sensibility" (p.368). With deeper roots still, Taylor (1989) argues that whilst sweeping generalities, Enlightenment and Romantic cultural currents compete in modern debates about how to define and respond to environmental issues (see also Hedlund-de Witt, 2013a). "The battle between instrumental reason and this [Romantic] understanding of nature still rages today in the controversies over ecological politics. [...] One sees the dignity of man in him assuming control of an objectified universe through instrumental reason. If there are problems with pollution or ecological limits, they will themselves be solved by technical means, by better and more far-reaching uses of instrumental reason. The other sees in this very stance to nature a purblind denial of our place in things. We ought to recognize that we are part of a larger order of living beings, in the sense that our life springs from there and is sustained from there (Taylor, 1989: 384)"[13].

These paradigms, pervasive in literary accounts of prevailing temporally and spatially located ecological 'worldviews', have undoubtedly held salience in the cultural imaginaries of dominant groups. And such groups have exchanged related narratives to legitimate and support their prevailing interests (Cotgrove, 1982). However as will be discussed in chapter 3 (see especially section 3.4), more recent literatures have been critical of attempts to curate binary understandings and finite categorisations of perceptions of nature. At risk of truncating the subtleness and messiness of interpretations of nature, efforts to closely define and represent nature across spatial and temporal contexts risk overlooking its unavoidably political character (Smith, 2013) and situating philosophies of nature too within the 'hall of mirrors' (Rose, 1999).

[13] Originally cited in Hedlund-de Witt (2013b).

2.8.4 Technologies Produce and Reproduce Different Natures

As Corner et al. (2013: 939) write, "because some new technologies alter or mediate the way in which people interact with their natural environment, they have frequently acted as lightning rods for debates about appropriate levels of human intervention in natural processes". And thus geoengineering is only one of the latest in a long line of technological developments – including genetic modification, nanotechnology, nuclear power and carbon capture and storage – that has provoked debate about the desirability and feasibility of humans attempting to control, shape or manage natural systems (Davies & Macnaghten, 2010; Gaskell et al., 2000; Kearnes et al., 2006; Mabon et al., 2013; Shaw, 2002; Sjöberg, 2000, 2004). As Kearnes & Macnaghten (2006) note, by challenging and threatening deeply held notions of 'naturalness', 'humanness' and agency, (c.f Frodeman, 2006), such technological developments have caused society to "rethink received notions of nature and culture" (Hastrup, 2013: 3), at times provoking shifts in prevailing narratives and realities (Macnaghten & Urry, 2000, 1998).

2.8.4.1 Geoengineering as a Unique Challenge

Geoengineering has, nevertheless, been argued to have unprecedented potential to recalibrate the parameters through which received notions of nature and human agency are constructed and to establish a new relationship between nature and society (Hamilton, 2013; Macnaghten & Szerszynski, 2013; Yusoff, 2013). The novelty of geoengineering does not lie in the technological developments themselves Macnaghten & Szerszynski (2013) note, since many of the proposals rely on comparatively unsophisticated and long-established techniques. Instead, the originality of geoengineering and its unique challenge to established notions of the relationship between nature and human society, lies in its dual identity as a technological endeavour of both 'global' and 'intentional' remit. On this I will briefly elaborate.

Beginning with such endeavors as agriculture and domestication of animals, continuing more recently to debates about for example, the potential impacts of a nuclear leak, human intervention in natural systems has typically been situated within a locally defined context of varying scales. To many, geoengineering technologies are therefore qualitatively different since, as Haqq-Misra (2012, 985) comments, "the ability for humans to use technology to modify their environment on a global scale is unprecedented in the history of life on Earth". Having the potential to change the relationship between humanity and the natural world across all social, political, cultural and economic domains and across all spatial scales with enduring consequence, makes geoengineering what Hedlund-de Witt (2013b: 3) labels an "integrative policy-concept". For these reasons Jasanoff (2010), argues that the allied issue of anthropogenic climate change requires a "revolutionary reframing of human-nature relationships".

As discussed in section 2.2, in addition to scale, intentionality is frequently identified as a definitional attribute of 'geoengineering', differentiating it from other inadvertent anthropogenic impacts on the climate system (Clingerman, 2014; Corner et al., 2013; Jamieson, 1996; Galarraga and Szerszynski 2012). Understood in these terms, geoengineering represents an additional intervention into the climate system to anthropogenic climate change. Thus of solar radiation management Galarraga & Szerszynski (2012: 221) write, geoengineering would create "a climate that has not just been *disturbed* by human intervention but has been *intentionally shaped* by human intervention". By knowingly planning and implementing the Anthropocene era (Crutzen, 2002a, 2002b; Steffen et al., 2011a, 2011b; Zalasiewicz et al., 2011), geoengineering becomes "another conceptual leap" (Corner et al., 2013: 3) towards realizing McKibben's (2003[1989]) "End of Nature" hypothesis.

2.8.4.2 "Making" Climates

While remaining an extension of wider debates about human influence on natural systems (Clingerman, 2014), these features of geoengineering mean that, if implemented, geoengineering clearly has the potential to widen for some the meaning of what it is to live within the "Anthropocene" (Galarraga & Szerszynski, 2012; Preston, 2012) and thus to further reconfigure meaning-making about the human relationship with nature. Of this Clingerman (2014: 12) writes, "by *making the choice* to humanize the very atmosphere of existence and thereby *self-consciously enter* a new geologic era – the very definition of humanity changes. Climate engineering becomes more than just a technical fix; it is the occasion for a new model of our place, of our relation to the nonhuman world, and of the human being itself".

Galarraga & Szerszynski (2012) explore how SRM specifically may draw humanity into a new relationship with nature, by asking how imaginaries of geoengineering may construct different accounts of human agency, or of the "makers" of climate. Another way to phrase the central tenet of their research question would be they say, to ask "what *kind* of god would we become if we started to make the climate?" (Galarraga & Szerszynski, 2012: 234). Characterizing three modes of climate "maker" – a climate architect, artisan and artist – these models they suggest do not themselves lead to specific moral positions about the acceptability of geoengineering interventions per se. Rather they raise metaphysical questions that "force us to think about what it is to be a being that makes things and what it might mean to bring the climate into the orbit of human making" (Galarraga & Szerszynski, 2012: 233).

2.8.4.3 The Implicit Anthropology of Geoengineering

Moral positions do nevertheless interact with these modes of making. Geoengineering discourse can variously be seen casting would-be geoengineers in such terms as 'pioneers', 'innovators',

'explorers' and 'problem solvers' seeking to navigate new terrain and also as 'crazy', 'ludicrous', 'arrogant', 'hubristic' and 'reckless' 'rogues' (Porter & Hulme, 2013). Accordingly we see at the heart of the debate on geoengineering not only different conceptions of nature, but also discordant interpretations of the human identity and place within the world. As geoengineering demands human self-interpretation of who we are and want to be, it thus has an implicit "theory of anthropology" Clingerman (2014: 10) writes.

Dissecting this assertion, Clingerman traces the implicit anthropology of narratives espousing an anti-geoengineering stance and contrasts this with discourse of geoengineering 'proponents'. An anti-geoengineering stance, Clingerman (2014: 10) suggests, defines human engagement with geoengineering in terms of limitation and arrogance. Emphasizing the finitude of human knowledge and human fallibility, as well as the culpability of past fossil fuel use, under such logic prudence and humility should prevail in geoengineering decision-making. The essence of the human condition is defined in reference to the human relationship with the planet, and for Clingerman an anti-geoengineering stance sees nature and climate as functioning independently of humanity. An anti-geoengineering stance, Clingerman (2014: 10) concludes "advances a sense of the human as a steward who must maintain the separation of the natural and the artificial". Such an anthropology echoes, for example, Bill McKibben's (2003[1989]) "End of Nature" narrative. Widely deployed in geoengineering discourse (Porter & Hulme, 2013), McKibben's thesis offers value only to a 'pristine' and external nature, untouched by humanity.

Clingerman's (2014) account of the implicit anthropology in the discourse of geoengineering 'proponents', contrastingly positions humans in a reflexive engagement with the natural world through which human agency and innovation in science and technology may be used to recreate or redefine the natural in active restoration of the planet. In such an anthropology, Clingerman finds the scope of human power and existing influence over the planet and climate to be emphasized. Given this existing impact, proactively and reflexively defining the terms in which this influence is exerted is deemed prudent. "Mastery of the climate is unwillingly accepted as necessary to overcome the previous mastery of nature", Clingerman (2014: 12) surmises. Geoengineering proponents accordingly see geoengineering as an attempt to reintegrate humans with the global environment.

Literatures on the coproduction and hybridity of nature (e.g. Hinchliffe, 2007; Monbiot, 2013; Soper, 2000[1995]) may prove particularly enlightening in elaboration of such an anthropology. Emma Marris' (2011) *Rambunctious Garden* for example challenges the notion of a 'pristine wilderness' as both an unattainable and arbitrary human construction. Calling for the renunciation of this goal and its replacement with ambitions to actively reclaim the 'natural' with the possibility

of 'making new natures', at least one prominent geoengineering researcher, David Keith, has espoused Marris' proposal in defense of geoengineering research (McLaren, *in preparation,* see also Buck, 2010).

2.9 Moving Forward Through an Interpretative Lens

Given the limited empirical work that exists to date, Clingerman (2014) calls for more research to draw out the implicit philosophical assumptions about the nature of nature, technology and human agency that play out in human meaning-making about geoengineering. As illustrated in the research questions detailed in chapter 1, this thesis aims to make just such a contribution.

A multitude of analytical lenses could be used to scrutinize accounts of geoengineering. However as has been discussed in this chapter, 'nature' and human agency have consistently emerged as significant and fascinating features of discursive meaning-making about geoengineering. By focusing on what will in chapter 3 be conceptualized through the nomenclature of "ecological worldviews" – an interpretative framework for exploring ontological, epistemological and axiological assumptions in human meaning-making about the nature-society interactions of geoengineering – this work will attempt to imitate earlier studies of science controversies that have fostered deep examination of complex and remote policy disputes by scrutinizing that issue through a given analytical lens (e.g. Nisbet, 2005).

Human geography has much to offer to the question of how wider understandings of nature and human identity may play into geoengineering meaning-making (Yusoff, 2013). Questions such as 'what does it mean to 'restore'?', 'what is nature?', or as Hulme (2012a: 9*) asks of geographers, "what's the nature of this 'geo' being engineered?", are familiar to geographical work (e.g. Eden, 2002; Smith, 2013). As Smith (2013: 354) describes, human geography is particularly well suited to such an investigation since geography considers "not only the restoration of nature, but also the restoration of society's relationship with nature". Human geography has embraced, indeed actively advanced, the theoretical and methodological dynamism necessary for the post-normal study of upper-case Geoengineering. Geography makes space for meaningful exploration of the multiple and often competing constructs of nature and human agency that appear to lie at the heart of geoengineering discourse.

Geography's preoccupation with place presents a further interesting opportunity for geoengineering research. As will be explored in section 3.8.2, meanings of place have been reimagined and reassembled with the rise of new kinds of place (Amit, 2000), and increasing recognition of the necessarily constructed nature of 'place' (e.g. Tuan, 2001[1977]). Nevertheless human geography tells us that place matters as a centre of meaning in human life (e.g. Creswell, 2004; Livingstone,

2003) and the meaning of geoengineering will be anchored in and shaped by spatial forces, varying from place to place and understood differently in different locations. As will be described in chapters 3 and 4, this thesis accordingly departs from the recent, and until now arguably necessary, convention of geoengineering social science literature exploring perceptions of geoengineering in controlled, survey or focus-group-type settings. Instead, by developing an in-depth case study of perceptions of geoengineering in a situated, real-life context, in keeping with geographical traditions analysis can be anchored in place and explore distinctive contextual dimensions.

Chapter 3: Conceptualising Ecological Worldviews and the Case of the Haida Salmon Restoration Corporation

Chapter 2 argued that debates about geoengineering are in a sense debates about human identity, about the nature of reality, about the knowledge we acquire and about the futures we desire. Most particularly it argued that geoengineering – given its great potential to mediate the way in which people experience and interact with their natural environment – invites particular reflection on the nature of 'nature' and of the position of humans in relation to the natural world.

Conflicting and seemingly polarized perspectives in environmental issues have often been framed as being underpinned by divergent 'worldviews'. In the climate change debate for example Hulme (2012b: 224) argues that "the underlying reasons for the public arguments that flare around climate change… are to do with the different worldviews, beliefs, ideologies and values of different cultures, social constituencies and political interests". Hedlund-de Witt (2013b: 74) describes worldviews as "inescapable frameworks of meaning and meaning-making that profoundly inform our very understanding and enactment of reality". Worldviews inform how we conceptualise the ecological issues we encounter she writes, but so too do they shape how we construct responses.

The 'worldview' concept is familiar to environmental research (e.g. Calicott, 2011; O'Brien et al., 2009; Thompson et al., 1990) and there have been calls for further developing environmental research on worldviews (Hulme, 2009). This chapter is going to argue for the usefulness of the concept of ecological 'worldviews' as a conceptual lens through which to go about unraveling the diverse beliefs, values and assumptions about the role and nature of 'nature' and human agency in geoengineering debates.

3.1 The Contested Concept of Worldviews

In academic literatures the term 'worldview' has been used and developed by diverse disciplines, including most notably philosophy, religious studies, and the social sciences of sociology, psychology and anthropology. Yet across, and indeed within, these disciplines the notion of worldviews is employed by scholars of diverse epistemology, in a variety of ways and contexts. Its meaning and application therefore remains much contested (Naugle, 2002). The conceptual ground of 'worldviews' is further muddied since the term's overall role in language is often assumed implicit. Indeed at times it is employed prolifically alongside little analytical reflection on its use and precise meaning. Most notably 'worldview' often appears uncritically alongside – and at times is even used interchangeably with – such terms as 'ideology', 'values', 'beliefs', 'attitudes', 'ontology', 'cosmology', 'paradigm', 'identity', 'religion', 'culture', 'ethics' and 'imaginary'.

Highlighting definitional contestation, and debate about how to operationalize empirical investigation of the concept, Koltko-Rivera (2004: 22) notes some of the contested points in theories of worldviews when he asks: "What sort of construct is "worldview"?... How are worldviews structured?... Worldview theorists generally agree that worldviews affect behavior, but how precisely does this happen? Where do worldviews "fit in" among the various cognitive and personality structures and functions? Do worldviews affect basic processes of concept formation? Perception? Sensation? Or are worldviews farther "downstream" in the processes of cognition?... Where does one *go* with worldview? What research is worth doing with the worldview construct?"

Given 'worldviews' heterogeneous function, this section of my thesis will seek to clarify the understanding of 'worldviews' on which this research will be based, and thus to establish the research conceptual framework. This task will involve offering some reflection on the concept's diverse usage and application in existing literatures. However this contribution will be limited given that such a review has been fluently and comprehensively undertaken by others (e.g. Hedlund-de Witt, 2013b, 2013c, 2012; Naugle, 2002).

Instead, piggy-backing particularly on the work of interdisciplinary sustainability scholar Annick Hedlund-de Witt, the primary ambition of this section of the thesis is to build towards a practical and paradigmatically meaningful approach to empirically operationalising the 'worldviews' concept in this thesis. Given that the way in which one understands the idea of 'worldview' – its form and function – is an expression of ones own 'worldview' (Hedlund-de Witt, 2013c; Koltko-Rivera, 2004; Naugle, 2002; Sire, 2004), this chapter also overtly and critically engages with the paradigmatic foundations of the research.

3.2 'Worldview' as "Our Intuition of the World"

The concept of 'worldview' has been first attributed to the writings of 18th century philosopher Immanuel Kant (Naugle, 2002). Later described in the English language through the terminology of 'worldview', Naugle (2002: 58-59) translates Kant's understanding of 'weltanschauung' as "our intuition of the world". Since its conception as 'weltanschauung', the concept of 'worldview' has a long and dynamic evolutionary history (see especially Hedlund-de Witt, 2013a, 2013c, 2012; Naugle, 2002; Tarnas, 2010). However in many ways aspects of this Kantian 'worldview' have survived the "long battle of ideas" in 'worldview' theory (Tarnas, 2010: xii) and this translated extract continues to be widely echoed in more recent literatures.

In the political science literature Inokoba et al. (2010: 24) describe 'worldview' as a "look onto the world". It refers they say "to the framework of ideals, values and belief systems through which an individual interprets the world and interacts in it". In theological literature Smith (2010: 28)

meanwhile similarly remarks that 'worldview' "provides the grid or framework through which we "make sense" of the world – the 'set of hinges' on which our thinking and doing turn". Literature commonly denotes that our 'worldview' is at the core of how we experience life. It determines our reality and what we think of as common sense about the world. As articulated most explicitly by Sunshine (2009: 13-14), 'worldview' addresses and determines our assumptions about higher order questions like "what is real?", "what can I know and how can I know it?", "are there such things as right and wrong?" and "if so, how do I know what they are?"

'Worldviews' inform our perception and knowledge of such things as risk, politics, economics, religion, culture, science and ethics (Douglas & Wildavsky, 1983; Inokoba et al., 2010). Similarly 'worldviews' find expression in discourse, and practices, and shape our actions, responses and policy preferences (Hedlund-de Witt, 2014, 2012). But our understanding of the world also engages with how we understand our place within it. So on a more introspective level, a 'worldview' situates us in the world, speaking to who we are and to what matters to us[14].

3.2.1 Worldview as Comprised of Ontological, Epistemological and Axiological Assumptions

Reflecting this extensive scope, literatures of diverse discipline have consistently highlighted fundamental aspects of 'worldviews' to include at the very least the philosophical concepts of ontology, epistemology and axiology (Hedlund-de Witt & Hedlund-de Witt, 2015, *in press*; Hedlund-de Witt, 2013a, 2013b, 2013c, 2012; Johnson et al., 2011; Kawagley et al., 1998; Naugle, 2002; Sire, 2004). These are dominant subject areas in philosophy (Hedlund-de Wiitt, 2012, 2013a) and also among the paradigmatic foundations of research design (Wilson, 2001). While each of these aspects covers diverse semantic ground, they are interrelated.

Ontology refers to the assumptions one makes about the form and nature of reality and the world in which one lives (Johnson et al., 2011; Welty, 2003; Wilson, 2001). Through ontology worldviews therefore offer a perspective on what entities can be said to exist (Hedlund-de Witt, 2012; Sire, 2004) and as typified by the question "what is?", ontology encompasses questions about the nature of the world and how it is structured and functions. Ontology is thus often enriched by institutionalized as well as less formalized cosmological beliefs that interpret the origin of the universe, nature and the divine (Johnson et al., 2011).

Epistemology is intimately intertwined with ontology, offering an account of how we acquire knowledge of the nature of reality (Hedlund-de Witt, 2012; Trochim, 2006; Wilson, 2001). Constructing a theory of knowledge, epistemological dimensions of 'worldviews' speak to such questions as how does knowledge come about and through what means? Hedlund-de Witt (2013a)

[14] Again Smith's (2010: 28) work usefully develops these ideas: "A worldview tells us something about our *calling*… [it] shape[s] our *identity* by constituting the telos of our being-in-the-world".

highlights for example the diverse knowledge claims that may arise from empiricism, artistic pursuit, instinct, experience or divine revelation. Through epistemology 'worldviews' also connote a perspective on what knowledge is valid and how we can demonstrate truth and legitimacy (Naugle, 2002; Vidal, 2008).

Axiology speaks to what is "good" and "right" in the world and thus through axiology 'worldviews' define the ethics, morality and aesthetics that determine quality of life. Hedlund-de Witt (2012: 80) summarizes that axiology traditionally deals with beliefs that determine what "the good life" looks like; connoting what is in the world is of value, what matters, what is desirable, and equally what should be avoided. Philosophers often describe axiology as offering a perspective on how individuals negotiate their identity, defining who they are by where they find meaning and importance (Hedlund-de Witt, 2013a).

3.3 Worldview as a Co-Created Overarching System of Meaning-Making

This study works from the definition of 'worldview' articulated by Annick Hedlund-de Witt (2012: 75) who describes 'worldviews' as "inescapable, overarching systems of meaning and meaning-making that to a substantial extent inform how humans interpret, enact, and co-create reality". This definition highlights several crucial conceptual features of 'worldviews' that will briefly be elaborated: Notably that the ontological, epistemological and axiological assumptions of 'worldviews' should be understood as a holistic structure, with a certain logical coherency and that 'worldviews' are co-produced through socialization, discourse and symbol (see also Hedlund-de Witt & Hedlund-de Witt, 2015, *in press*).

3.3.1 Worldviews as a Holistic Structure

To address the first of these features, Hedlund-de Witt's definition sees 'worldviews' as "not a patchwork of loosely related phenomena, but as a coherent pattern or *system* that integrates seemingly isolated ideas into a common holistic structure" (Hedlund-de Witt, 2012: 75). The characterization of 'worldviews' as largely all-encompassing reflects a notion espoused by other worldview theorists as far back as Kant: The idea that 'worldviews' constitute ultimate justifying ideas that shape nearly 'everything' we experience, and pertain to almost the entirety of our perspective on the world[15] (Hedlund-de Witt & Hedlund-de Witt, 2015, *in press*; Inokoba et al., 2010; Johnson et al., 2011; Olsen et al., 1992).

From this assumption previous authors have offered an account that positions 'worldviews' as the deeper, more encompassing, even 'primative' (Rokeach, 1968: 6) philosophical foundational

[15] Inokoba et al. (2010: 24) for example suggest that 'worldview' "pervades and influences most of our thinking and actions". For Inokoba et al. (2010: 25) 'world' in worldview "means the totality, everything that exists around us, including the physical universe, the earth, life, mind, society and culture".

structures that underlie and shape the other 'subordinate' knowledge and symbolic frameworks that give meaning to human existence (Laughlin, 2007; Koltko-Rivera, 2004; Olsen et al., 1992). To differentiate between 'worldviews' and these, what are often described as more 'surface positions', Koltko-Rivera (2004: 4) reiterates that the basis of 'worldviews' lies in ontological, epistemological and axiological assumptions. 'Worldview beliefs' he writes are those which speak to the "underlying nature of reality, 'proper' social relations or guidelines for living, or the existence or non-existence of important entities".

To address the idea of 'worldviews' having a degree of logical coherency, Hedlund-de Witt (2013a: 79) explains that "the different aspects of worldviews relat[e] to each other in a consistent, interwoven manner, meaning that they are interrelated to the point of forming an emergent, structured whole or system". As will be discussed in section 3.4.3.1 Hedlund-de Witt reconstructs such a logical coherency across three families of ideal-typical 'worldviews' that her research identifies as being dominant within Western societies. Whilst conceding that these categories offer only "sweeping generalization of the complexities and ambiguities of reality" (Hedlund-de Witt 2014: 8316), these logically constructed models line up a certain view of 'Nature' with a certain human image.

Importantly however Hedlunde-de Witt explicitly states that this coherency does not imply that 'worldviews' are expressed consistently and without contradiction or paradox. Echoing Wilber, (2000) who draws on the work of Noam Chomsky, Hedlund-de Witt also emphasizes that in terms of their culturally and individually relative surface expressions, the way in which 'worldviews' are articulated and enacted will vary enormously "For example, a traditional ontology will be expressed through different surface contents depending on whether that worldview is situated within a Christian or Hindu religious-cultural context, but will share certain underlying commonalities", she writes (Hedlund-de Witt & Hedlund-de Witt, 2015, *in press*: 23).

Understanding of the heterogeneous expression of worldviews is further elaborated by Smith (2010: 28-29) who, building on Federico et al.'s (2009: 259) conceptualisation of 'worldviews' as "pre-political", characterizes 'worldviews' as "pre-theoretical" operating "even prior to thought". Revealing an inherently imaginative and creative dimension to 'worldviews' Olthuis, (1985: 21-40) argues that 'worldviews' may be used to construct a response to questions that "elude our intellectual grasp". Even when people do not have a full understanding of an issue "worldviews… may serve as simple metaphors that allow even those who do not clearly understand the "forensic" content of various ideologies and the policy preferences that they entail to make political choices that broadly accord with what they see as essential to the good life" (Federico et al., 2009: 263-264).

3.3.2 Worldviews as Enactive and Co-Created

In the context of perceptions of geoengineering and climate change, chapter 2 advanced the constructionist notion that beliefs and values interacting with the climate change debate have a shared element, being socially derived, maintained and reconstructed by interactions with the culture and social institutions of society. By highlighting the enactive and co-creative dimensions of 'worldviews' in her definition and indeed by synthesizing her analysis of dominant 'worldviews' in the West into a set of distinct ideal-typical 'worldview' typologies (see section 3.4.3), Hedlund-de Witt (2014, Hedlund-de Witt et al., 2014) is similarly arguing that socialization in shared experience and discourse is inherent to the construction and reconstruction of 'worldviews'. 'Worldviews' she writes, have "complex, reciprocal relationships with the world(s) that they bring forth—and are (recursively) brought forth by" (Hedlund-de Witt & Hedlund-de Witt, 2015 *in press*: 5).

That 'worldviews' are both idiosyncratic and culturally informed is an argument that has been put forth by a range of other scholars (e.g. Douglas and Wildavsky 1982; Inokoba et al., 2010; Johnson et al., 2011; Sunshine, 2009; Taylor, 2004, 1989). And appreciation of this socialization and the power of social symbols and images in cultural patterning is fundamental to understanding how particular knowledges and significations about the world gain and retain power (Berger & Luckmann, 1963; Burr, 1995). Such coproduction means it is not possible to meaningfully separate the individual from the social and so it is commonly held that in the study of 'worldviews' it is necessary to situate the individual within their social and institutional context.

In an ethnography of climate change perceptions Norgaard (2011) similarly argued that the social context is of fundamental importance in understanding how people respond to climate change. "Studies of perception that focus solely on individuals are unable to grasp the meaning of differences across cultures, subcultures, nationality, or the influence of political economic context on how individuals and communities think, feel and imagine" she writes (Norgaard, 2011: 209). As will be discussed in section 4.1.1, this research has sought to reflect this constructionist epistemology through a research design that doesn't just explore how specific individuals come to interpret and make sense of geoengineering, but that also seeks to identify the social and shared aspects of these processes of meaning-making.

3.3.3 Worldviews with Shared Features May Still Have Heterogeneous Expression

As a result of sociocultural learning and engagement, previous studies of 'worldviews' have identified shared and recurrent features of 'worldviews'. However these shared features do not preclude 'worldviews' from exhibiting heterogeneous expression. Even Annick Hedlund-de Witt, and co-author Nick Hedlund-de Witt who, as will be discussed in section 3.4.3, evidence three 'worldviews' that they find pervasive in the West, crucially note that these 'worldviews' are not rigid

characterizations of people, but rather are ideal-typical representations of observed similarities. Human beings by nature are too complex to be exhaustively disclosed through a theoretical framework, they state (Hedlund-de Witt & Hedlund-de Witt, 2015, *in press*). Highlighting the dynamic and fluid nature of 'worldviews' and their expression, they write "individuals do not simply hold one worldview in a monolithic manner, but rather tendentially or probabilistically inhabit a predominant worldview, while expressing elements of other worldviews depending on a variety of contextual variables" (Hedlund-de Witt & Hedlund-de Witt, 2015, *in press*: 23).

3.4 Previous Frameworks Employed in the Empirical Investigation of Worldviews, Attitudes and Values in Environmental Research

Now a conceptual position on 'worldviews' is starting to emerge, this chapter's attention turns to exploring how an investigation of 'worldviews' has been empirically operationalized.

Interest in what Hedlund-de Witt (2012: 75) calls the 'intangibles' – 'worldviews', 'values' and 'attitudes' – has long been of interest to environmental social sciences (Kearney, 1975). As Heinrichs & Gross (2010: 1) write, "sociological questioning pertaining to the role of 'Nature' in society is as old as the discipline of sociology itself". Thus the way in which 'worldviews' have been explored in environmental research is a predictably vast topic. A comprehensive review of all possible conceptual and methodological approaches from different disciplinary and theoretical perspectives is beyond the scope of this thesis. However by reflecting on a small sample of widely used and commonly cited approaches to empirically investigating ideas of 'worldviews' and environmental 'attitudes' I hope to highlight some of the strengths and weaknesses to different constructs which, after focusing the paradigmatic basis of the research, can inform my own approach.

3.4.1 Psychometric Approaches to Empirically Investigating Worldviews

In academia the study of environmentally-oriented 'worldviews' and 'attitudes' has often been reliant on a series of binary codes (Brulle 1996; Hedlund-de Witt, 2013) which have focused on exploring such dimensions of people-environment relations as intrinsic and instrumental values of nature, the extent to which people report feeling connected with 'nature' and the types of solutions to environmental problems that respondents prescribe through such binaries as 'techno-optimism' verses 'techno-pessimism' and resource 'preservation' verses 'utilization'.

Studies have incorporated for example Cotgrove's (1982) distinction between 'catastrophist' and 'cornucopian' environmental 'attitudes', (which reflect almost archetypal techno-pessimist and techno-optimist positions) into scales that explore the diverse social prescriptions for tackling environmental challenges. In this vein, Milfont and Duckitt (2004) developed an 'Environmental

Attitudes Inventory' to assess 12 prescribed dimensions of environmental 'attitudes'. From this they identified two highly correlated 'higher order' factors that they named '*preservation'* and '*utilization'*. Interpretations of these factors emphasized the importance of individual behaviour change and regulation, and of science, technology and market mechanisms respectively.

Building on philosophical distinctions discussed for example by Stokols (1990), Thompson & Barton (1994) are among those that have drawn a distinction between 'anthropocentric' and 'ecocentric' perspectives on the natural world to differentiate between instrumental and spiritual views of 'nature' (see also Chandler & Dreger, 1993). These categories are respectively used to denote a belief in preserving 'nature' because it can contribute to the satisfaction of human kind, and a belief in valuing 'nature' and affording it moral consideration in its own right (see also De Groot et al., 2011). Schultz (2000, 2001) similarly developed a measure to assess the extent to which people view themselves as part of the natural environment and found a three-factor structure to environmental concerns which he labelled according to Stern et al.'s (1993) three varieties of 'altruistic', 'egoistic' and 'biospheric' environmentalism, to reflect the degree to which the factors reflect respondents empathizing with nature.

3.4.1.1 The New Ecological Paradigm

One of the most widely used measures of ecological 'worldviews' is the New Ecological Paradigm (NEP) scale that was developed in Dunlap & Van Liere (1978) and revised in Dunlap et al., (2000) (see also Manoli et al., 2007). Reflecting the inherent ambiguity to these phenomena, the NEP has been "treated variously as measuring environmental attitudes, beliefs, values and worldview" (Dunlap et al., 2000: 428). In its revised format it is designed to measure adherence to a 'proenvironmental orientation', characterized by the authors' interpretation of the dominant facets underlying contemporary environmentalism. The scale is designed to capture such dimensions as an ecocentric position described as 'anti-anthropocentrism', a fragile understanding of the balance of nature, rejection of human exemptionalism, pronouncement of limits to growth, recognition of the possibility of an ecocrisis and acknowledgement "that human societies depend on their biophysical environment for survival" (Dunlap, 1980: in Hedlund-de Witt, 2013).

The NEP has been widely used to measure and compare orientations and its items have been combined and restructured in the scales adopted across a number of studies (e.g. Cotgrove, 1982; Ellis & Thompson, 1997; Milbrath, 1984; Olsen et al., 1992; Shwom et al., 2010). The NEP has been found to strongly discriminate between groups of self-reporting environmentalists and the general public (e.g. Widegren, 1998) and significant relationships have been found between the NEP scale and behaviour and behavioural intentions (e.g. O'Connor et al., 1999).

Other studies of environmental 'views' have claimed to have identified similar beliefs in environmental meaning-making to those captured in the NEP (e.g. Kempton et al., 1995). Further in its newly revised format the NEP exhibits fairly strong psychometric properties, including most notably a high internal consistency. Indeed Dunlap et al., (2000) found removing any of the items in the scale lowered the coefficient alpha. This has been offered as evidence that the NEP may constitute a measuring instrument of a coherent 'worldview' and, at the very least, that the NEP "constitute[s] a fundamental component of people's belief systems vis-à-vis the environment" (Dunlap et al., 2000: 428).

3.4.1.2 Limitations to Such Psychometric Approaches to Measuring Environmental Attitudes.

The approaches considered above do not all claim to measure 'worldviews' per se. However their usefulness for this study remains particularly limited by their preoccupation with measuring environmental meanings by focusing on particular given dimensions of environmental 'attitudes', that are often constructed through a single central binary. It has been argued for example that while the NEP may successfully address the instrumental and ecological interconnectedness of humans and 'nature' and thus makes a meaningful contribution to questions of how societal problems and issues should be addressed, the scale neglects intrinsic, spiritual or metaphysical connections to 'nature' (Hedlund-de Witt, 2013a; Lockwood, 1999; Van den Born, 2008). Hedlund-de Witt (2013a) meanwhile notes that even though scholars tend to attest that *how* we know is inherently entangled with, and thus of importance to, *what* we know (and value), epistemology is a particularly neglected facet of 'worldviews' in this field of research. As a result of these omissions and narrow foci, most of these reviewed scales cannot meaningfully claim to offer any kind of comprehensive overview of ontological, epistemological and axiological assumptions about the nature of the earth and humanity's relationship with it.

That these reviewed approaches are frequently conceptually and methodologically constructed around one or two diametrically opposed binary distinctions, has been offered as a further challenge to their utility (Hedlund-de Witt, 2012; de Groot et al., 2011). At their poles, dichotomous continua based on such concepts as 'preservation' versus 'utilization', 'ecocentrism' versus 'anthropocentrism', 'human exceptionalism' versus 'ecological interconnectedness' are able to express positions that are seen in total opposition to each other. But by considering these positions to be mutually exclusive polarities, these scales are unable to account for the possibility of more nuanced perspectives that in some way integrate these seemingly 'dichotomous' assessments. As a result perspectives may be conflated, masking opportunities to explore the ways in which these positions may be integrated (Hedlund-de Witt, 2013a).

Another fundamental problem with the NEP scale, and with other approaches that mimic its

format, is that the NEP implies there is a cultural consensus as to what constitutes 'environmentalist values and beliefs', which imposes a sense of unity on society and leaves no room for the possibility of a coherent alternative. Yet research has found that beneath broadly shared environmental concerns there is substantial divergence around how human beings should relate to 'nature' and manage the environment (e.g. Ellis & Thompson, 1997; Hedlund-de Witt, 2013a). Furthermore, by creating a static depiction of 'environmentalism', such approaches are also poorly able to account for dynamic changes in social perspectives on the human-nature relationship (Hedlund-de Witt, 2011).

3.4.2 Cultural Theory

In an effort to provide a more satisfactory account of environmental 'beliefs' some sociologists have taken a dramatically different approach to that offered by the NEP and have drawn on Mary Douglas and Aaron Wildavsky's 'Cultural Theory' to claim that attitudes towards the environment are embedded within broader socio-cultural orientations (e.g. Ellis & Thompson, 1997).

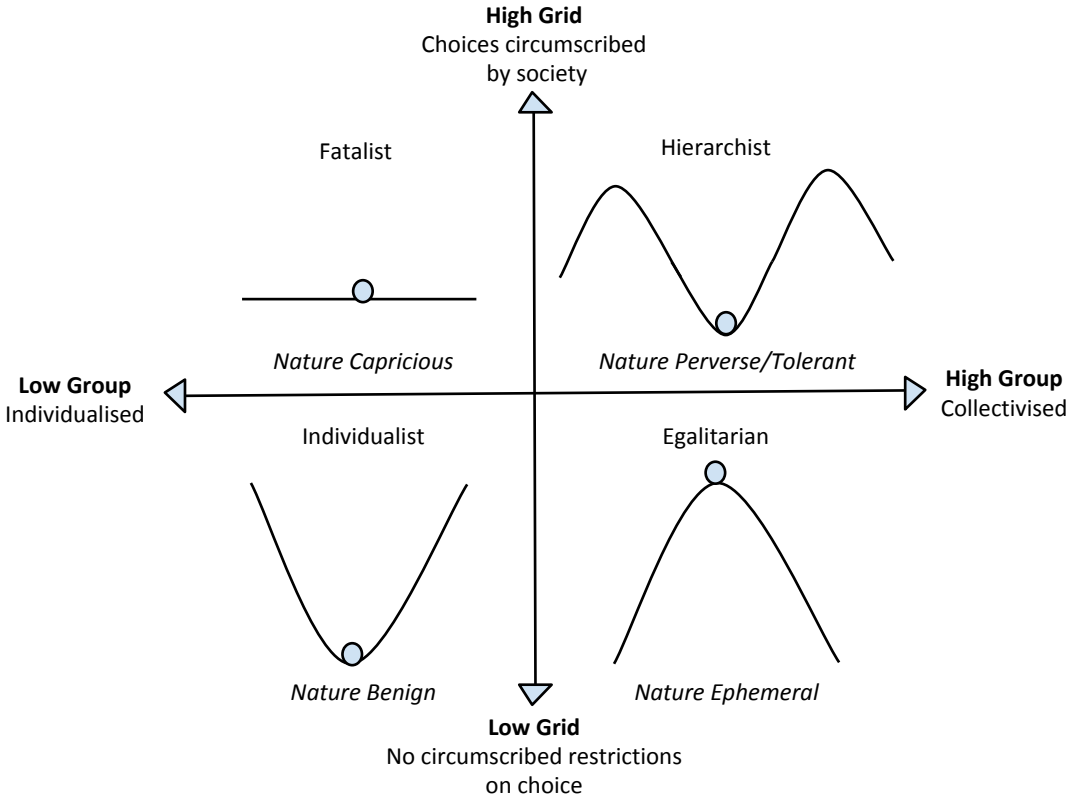
Cultural Theory was first proposed by Mary Douglas (Douglas, 2003[1982], 1978, Douglas & Wildavsky, 1983) who suggested that individuals adhere to particular patterns of social relationships, and that these correspond with, and legitimate distinctive worldviews, values and ways of living. They proposed these lifeworld orientations, or 'worldviews' could be characterized along two dimensions that they called 'grid' and 'group'[16]. On the strength of their grid-group characteristics, Douglas & Wildavsky (1983) described four ideal-typical cultures, which they labelled 'fatalism', 'individualism', 'egalitarianism' and 'hierarchy'. These solidarities are posited to be universally applicable on the basis that the two "dimensions of sociality grasp the fundamental nature of the social being" (Mamadouh 1999: 397)

Cultural Theory has been subject to a variety of interpretations and applications but has been particularly applied in the area of risk analysis, where conflict over environmental and technological 'risk' is seen to result from the incompatibility of these competing ways of life. (e.g. Finucane, 2002; Kahan et al, 2009; Peters & Slovic, 1996; Rayner, 1992). However theorists working with Cultural Theory have adapted it to encompass wider commitments in social and environmental imaginaries. Of particular interest to this study, following Holling (1986), Michael Thompson and colleagues (1990) proposed that four different implicit 'views of nature' could be mapped onto Douglas' grid-

[16] "Group refers to the extent to which an individual is incorporated into bounded units. The greater the incorporation, the more individual choice is subject to group determination. Grid denotes the degree to which an individual's life is circumscribed by externally imposed prescriptions. The more binding and extensive the scope of the prescriptions, the less of life that is open to individual negotiation" (Thompson et al., 1990: 5).

group orientations (see Figure 3.1)[17].

Figure 3.1 The Four Myths of Nature that Correspond with the Four Cultural Outlooks Defined by Cultural Theory



Based on Schwartz & Thompson, (1990)

This application of Cultural Theory attests that environmental 'attitudes' are shaped by diverse preferences about how to organize and justify social and political life. The theory follows that those who subscribe to each cultural bias will construct policy preferences that support their preferred prescription for how humans should organize social and political life (Ellis & Thompson, 1997; Mamdouh 1999; Schwarz and Thompson 1990; Thompson 2008). As Thompson et al. (1990: 26) explain "these myths of Nature are the simplest models of ecosystem stability that, when matched to the different ways in which the managing institutions behave, render those institutions rational". Ellis & Thompson (1997: 885) offer some insight into how these myths interact with the preferred patterns of social relationships defined by Cultural Theory when they write "individualists construct a view of nature as forgiving and resilient because it makes it easier for them to justify laissez-faire and to resist those who would enhance centralized, governmental control". While "the idea of resources as nonrenewable and rapidly depleting is hypothesized as appealing to egalitarians

[17] See also Thompson et al., (1990), Schwarz and Thompson, (1990). A fifth myth, that Nature is 'resilient' was later added as a meta-myth that subsumes all others. However it is not easily represented graphically (Thompson et al., 1990).

because it enables them to justify regulating and redistributing limited resources". Appendix 3.1 offers a more detailed account of the fundamental dimensions to Douglas & Wildavsky's (1983) Grid-Group cultural orientations and of their associated implicit views of nature identified by Thompson et al (1990).

3.4.2.1 Critiques of Cultural Theory

That Cultural Theory can make a useful contribution to the interpretation of environmental 'beliefs' and 'preferences' has been widely attested (e.g. Bellamy & Hulme, 2011; Ellis & Thompson, 1997; Kahan, 2010; Kahan et al., 2011; Kahan et al., 2009; Marris et al., 1996; Peters & Slovic, 1996;). However it has also been subject to some notable criticisms. Some scholars have suggested Cultural Theory isn't supported by sufficient empirical evidence (e.g. Boholm, 1996). However critique is often particularly preoccupied with the theory's dependence on neatly bounded schema. Positing a finite number of ways in which the world can be constructed, inherently constrains socio-cultural relativism (Tebboth, 2014). Thus some, such as Forsyth (2009) find Cultural Theory too reductionist. Like the other reviewed psychometric approaches to exploring environmental 'attitudes', Cultural Theory these critics argue is overly dependent upon cultural abstraction and homogenization and thus forgoes nuance and diversity in the pursuit of order and simplicity[18].

Additionally, much like those approaches discussed in section 3.4.1, Cultural Theory as an analytical lens focuses the remit of research on particular aspects of environmental 'attitudes'. It responds particularly well to questions about how society should be organised to respond to environmental challenges, for example. But it deals less well to questions of cosmology or epistemology. It is likely that a fruitful enquiry into the role of Cultural Theory in shaping and polarizing 'attitudes' towards geoengineering could be conducted. Indeed Bellamy & Hulme, 2011 have begun to develop such an analysis. However much as scholars rebelled from the dominant hypothetico-deductive use of 'grand theories' in social research in the 1960s (Thornberg, 2012), I seek an approach that leaves me as a researcher as free and open as possible to discover and react to my data. Thus Cultural Theory has not been pursued as a theoretical framework in this study.

3.4.3 Hedlund-de Witt's Integral Worldviews Framework (IWF)

This review will draw to a close by considering a final framework for investigating different aspects of 'worldviews' that has been particularly influential on the design of the current research. In response to the piecemeal, and often binary, approaches to measuring 'worldview beliefs' in previous research, Annick Hedlund-de Witt developed the Integrative Worldview Framework (IWF) (Hedlund-de Witt, 2014, 2013a, 2013b, 2013c, 2012; Hedlund-de Witt & Hedlund-de Witt,

[18] Proponents of Cultural Theory refute this claim, arguing that Cultural Theory breaks away from the simple dichotomies discussed in section 3.4.1.2 that have dominated much of social science, and thus offers far greater nuance and sophistication of analysis (Thompson et al., 1990).

2015, *in press*). Hedlund-de Witt's ambition for the IWF was that it would offer a more comprehensive, systematic and dynamic conceptualization of the 'worldview' construct than seen in previous approaches. As well as developing a working definition of 'worldviews' (see section 3.3), the IWF was to serve as an analytical tool for reflexively and systematically exploring 'worldview' dynamics at an individual as well as a social level. The framework was intended to be universally valid; applicable in any research context where a researcher wants to conduct a holistic investigation of 'worldviews'[19].

To cement the otherwise amorphous concept in a more readily researchable construct, the IWF explicitly distinguishes and articulates 'worldviews' into five major dimensions and formulates exemplary questions for each aspect. The resulting interrelated aspects of ontology, epistemology, axiology, anthropology and societal vision are summarized in Figure 3.2 below. This approach is grounded in previous literatures since as discussed in section 3.2.1, there is a degree of interdisciplinary agreement around the significance of ontological, epistemological and axiological components to 'worldviews'. 'Anthropology' and 'societal vision' are effectively subsets of ontology, and of ontology and axiology respectively. However this further differentiation is intended to encourage researchers to explicitly investigate conceptions of the nature and role of the human being (for example in relation to their natural environment, c.f. Clingerman, 2014) and conceptions of how society should be organised and how societal problems should be addressed (including a perspective on how people imagine their preferred collective social life and on how challenges should be addressed) (Hedlund-de Witt, 2012, 2013a, 2013b, 2013c).

[19] Notably whilst the framework was intended to be universally applicable to research contexts, as will be discussed in section 3.4.3.1, using this framework Hedlund-de Witt & Hedlund-de Witt (2015, *in press*) have also developed a set of ideal-typical worldviews which they suggest offer heuristic characterizations of the dominant 'worldviews' in the West. These heuristics are distinct from the framework for analysis discussed here and are not afforded the same assumption of universal validity.

Figure 3.2 The Five Aspects of the Integrative Worldview Framework (IWF) Including Exemplary Questions and Concerns for Each.

Ontology	A perspective on the nature or reality, often enriched with cosmology. *What is the nature of reality? What is nature? How did the universe come about? If there is such thing as the divine – what or who is it, and how is it related to the universe?*
Epistemology	A perspective on how knowledge of reality can come about. *How can we know what is real? How can we gain knowledge of ourselves and the world? What is valid knowledge, and what is not?*
Axiology	A perspective on what a 'good life' is, in terms of morals and quality of life, ethical and aesthetic values. *What is a good life? What kind of life has quality and gives fulfillment? What are our most cherished ethical and aesthetic values? What is life all about?*
Anthropology	A perspective on who the human being is and what his [/her] role and position is in the universe surrounding him[/her]. *Who or what is the human being? What is the nature of the human being? What is his role and purpose in existence?*
Societal Vision	A perspective on how society should be organised and how societal problems and issues should be addressed. *How should we organise our society? How should we address societal problems and issues?*

(Reproduced with permission from Hedlund-de Witt, 2013c: 157).

Since, as discussed above, research has often focused on particular aspects or single dimension constructs of environmental attitudes, Hedlund-de Witt (2012: 75) sought to develop a holistic conceptualization of worldviews as "not a patchwork of loosely related phenomena but a coherent pattern or system that integrates seemingly isolated ideas into a common whole" (c.f. Campbell, 2007; Inglehart and Welzel, 2005). This means the IWF is intended to be comprehensive and encompassing enough as to permit reflection on each of the aspects of environmental attitudes facilitated by existing measures whilst ensuring that other previously underemphasized aspects – such as epistemological or spiritual commitments – do not go neglected.

The five aspects are also intended to facilitate an exploration of 'worldviews' in keeping with an understanding that 'worldviews' constitute "overarching systems of meaning and meaning-making" (Hedlund-de Witt, 2012: 80, c.f. Taylor, 1989). As such the IWF explicitly recognizes that although it draws distinctions between the five different foci, in reality it is not always possible to meaningfully separate them in this way. Instead Hedlund-de Witt (2013a: 79) understands these aspects to "complexly and interdependently hang together as truly 'overarching systems' in which the different aspects are related to each other in a somewhat logically coherent manner". The function of reflecting on each of these facets however is intended to "engender a more systematic, structural, and comprehensive articulation and investigation of 'worldviews' in survey and other empirical research" (Hedlund-de Witt, 2012: 81).

3.4.3.1 Application of the IWF: Traditional, Modern and Post-Modern Worldviews.

The Integrative Worldviews Framework emerged from research interested in exploring the significance of 'worldviews' in relation to environmental and sustainability issues and following its development, Hedlund-de Witt has applied the framework to this task with some persuasive results. Of particular note, Hedlund-de Witt (2013a) developed a set of Lickert scale items that she used to conduct a representative survey of 'worldviews' in the Netherlands, with the aim of exploring how these are related to environmental attitudes and behaviours. These Lickert items were informed by several existing scales but crucially were intended to broadly cover the five dimensions of the IWF framework and thus to span the dimensions of ontology, epistemology, axiology, anthropology and societal vision. Hedlund-de Witt considers the collection of 'beliefs' that a person holds towards the environment to be an integral part of 'worldviews'. However for the purpose of analysis she also distinguished those items that spoke specifically to positions on nature or the environment. Hedlund-de Witt then used principal component analysis (PCA) to explore the 'worldview' items, as well as the items designed to specifically describe 'environmental attitudes'. Her analysis generated five 'worldview' factors and three 'environmental attitudes' factors (Figure 3.3).

Figure 3.3 The labels Hedlund-de Witt (2013a) assigned to the five worldview factors and three environmental attitude factors generated by her principle component analysis of worldview items and environmental attitude items

Worldview Factors Labels	Environmental Factor Labels
'Focus on money' 'Secular materialism' 'Inner growth' 'Contemporary spirituality' 'Traditional God'	'Connectedness with nature' 'Willingness to change' 'Technological optimism'

As discussed in section 2.8.3, attempting to articulate and historicize the 'Modern Identity', Charles Taylor (1989) is among those scholars who have conceptualized a deep-seated contemporary tension in environmental debates between an Enlightenment-inspired instrumental, secular and materialistic understanding of reality and a post-Romantic commitment to inner growth and an intrinsic interconnectedness to the world.

For Hedlund-de Witt her interpretation of the five 'worldview' factors in her study resonate with Taylor's line of reasoning. The 'worldview' factors labelled 'Focus on Money' and 'Secular Materialism' she suggests speak to the former of these cultural currents, in which instrumental reason and the objectification of reality in pursuit of reliable knowledge interacts with secular and materialistic values and ultimately a more individualist perspective and an instrumental view of nature. The 'worldview' factors interpreted through the labels 'Inner Growth' and 'Contemporary Spirituality' meanwhile give expression to a feeling of deep intrinsic connection to the natural world and to the pursuit of aesthetic values and alternative ways of knowing, that are more compatible with a post-Romantic cultural current. The 'worldview' factors demonstrated the plausibility of

both spiritual/theistic and secular interpretations of these values. The factor labelled 'Traditional God' is meanwhile suggested to be representative of a more 'traditional worldview' in which divinity provides the ultimate justifying ideas and answers to life's fundamental questions. This factor emphasizes human exceptionalism and gives divine authority precedence.

Through exploring correlations between the 5 'worldview' factors and the 3 'environmental attitudes' factors (labelled 'Connectedness with Nature,' 'Willingness to Change,' and 'Technological Optimism'), the study also found ostensible consistencies between the intrinsic or extrinsic orientations of the 'worldview' factors and 'environmental attitudes'. These findings suggested the factors 'Inner Growth' and 'Contemporary Spirituality' are more compatible with a view that ecological challenges are best solved by humans 'recognising their place' in the natural order of life. While the Enlightenment-inspired 'materialist' orientated factors appeared to better understand the solution to environmental challenges as being through technical fixes (Hedlund-de Witt, 2013a).

Following other empirical and theoretical scholars (c.f Inglehart, 1997, 2000; Inglehart & Welzel, 2005; O' Brien, 2009; Ray & Anderson, 2000; Taylor, 1989), Hedlund-de Witt suggests that the results of this PCA begin to point to the existence in Dutch society of three predominant 'families of views', each with their own perspective on the fundamental priorities of society (c.f. Taylor, 1989). These factors bring forth contested notions about what is important in the world, why we are here, the purpose and meaning of life and the kind of society that is desirable (c.f. Ray & Anderson, 2000). To exemplify this Hedlund-de Witt (2013a: 140) writes, "the factor Inner growth does not only speak to personal (intrinsic) aspirations and values, but also gives expression to a certain ontology (e.g. life/reality has an inner dimension and is characterized by growth), epistemology (emphasizing non- rational modes of knowing), anthropology (human beings as egocentric), and societal vision (societal change starts within)".

Hedlund-de Witt builds on these observations to justify that the study factors appear to point to 'worldviews' as the wider and overarching constellations of meaning that have been described by multiple 'worldview' theorists (see section 3.3.1). Thus she concluded that the factors might be "*indications* of larger, more wide-ranging worldviews existing in society" (Hedlund-de Witt, 2013a: 140). The finding that she felt able to trace a discursive logical coherence between the factor interpretations and the wider literature on contemporary cultural understandings of reality (e.g. Inglehart, 2000; Inglehart and Welzel, 2005; Taylor, 1989; Ray & Anderson, 2000) further cemented this conviction. So too did the salience of these factors with other literatures that have suggested that different positions and opinions on environmental and sustainability issues can be understood in terms of cultural patterns or 'worldviews' (e.g. Hedlund-de Witt, 2014; Hedlund-de Witt et al., 2014; Levidow et al., 2012; Thompson et al., 1990).

Hedlund-de Witt (2013a, 2013b, Hedund-de Witt & Hedlund-de Witt, 2015) accordingly echoed a subset of this literature by describing the study factors (and the collections of ontological, epistemological and axiological assumptions that they begin to bring forth) in terms familiar to a number of scholars before her: As reflective of a more 'traditional worldview', a more 'modern worldview' and a more 'post-modern worldview'[20]. Hedlund-de Witt has since built on these observations through further literature review and empirical research (e.g. Hedlund-de Witt & Hedlund-de Witt, 2015; Hedlund-de Witt et al., 2015; Hedlund-de Witt et al., 2014). However Hedlund-de Witt continues makes this claim cautiously, acknowledging that the factors captured by her research portray only a fragmented signal to these 'worldviews'. Further as mentioned in section 3.3.1, Hedlund-de Witt does not suggest people conform to 'worldviews' in any kind of rigid way[21]. Instead she attests to the usefulness of these categories to refer to general homologies of perspective that, rather than fully describing, explaining or predicting 'worldviews', aspire only to highlight some of the most salient features (Hedlund-de Witt & Hedlund-de Witt, 2015, *in press*).

Whilst tentative, Hedlund-de Witt suggests this framework of at least three 'ideal-typical' 'worldviews' could serve as a useful heuristic for exploring the nature and structure of the major worldviews in the Western contemporary cultural landscapes. Further research has therefore offered an expanded articulation of these typologies in other Western cultural settings. Hedlund-de Witt additionally introduced the idea of an 'integrative' worldview, representing an attempt to "integrate many of the enduring elements of the earlier worldviews, and notably reconcile spirituality with rationality" (Hedlund-de Witt & Hedlund-de Witt, 2015, *in press*: 22). This 'worldview' is however less grounded in existing literature and is based around more limited empirical findings, so Hedlund-de Witt insists this remains more hypothetical (Hedlund-de Witt & Hedlund-de Witt, 2015, *in press*).

Taking care to emphasize the scheme's ideal-typical nature, Hedlund-de Witt delineated a provisional overview of the primary assumptions, themes, and concerns of each of these 'worldview's using the five 'worldview' aspects as an organising scheme. This heuristic has been recreated in appendix 3.2 with the author's permission.

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[20] O'Brien (2009) describes the value differences between these 'worldviews' as follows: "Traditional worldviews may, for example, place a greater emphasis on the set of values associated with conservation, which include tradition, security, and conformity. Modern worldviews may place emphasis on values associated with self-enhancement, such as power, achievement, and hedonism. Values linked to openness to change, such as stimulation and self-direction, may bridge both modern and postmodern worldviews. Finally a postmodern worldview may emphasize values that focus on self-transcendence, such as universalism and benevolence" (pp. 168- 169).

[21] On this Hedlund-de Witt & Hedlund-de Witt (2015, *in press*: 23) write "in our view, individuals do not simply hold one worldview in a monolithic manner, but rather tend to probabilistically inhabit a predominant worldview, while expressing elements of other worldviews depending on a variety of contextual variables".

Hedlund-de Witt's Integrative Worldviews Framework has been covered in this chapter in this more extensive detail since the heuristic framework for investigating different aspects of 'worldviews' plays a formative role in the study research design (see especially section 3.7). Further, as will be discussed in chapter 8, the general ideal-typical characterizations of predominant Western 'worldviews' that Hedlund-de Witt outlines in the IWF, were also found to have notable salience with the findings of this research. For these reasons the precise role of the IWF in this thesis will be returned to in section 3.7. But before clarifying this function, I want to briefly consider some of the paradigmatic questions that arise from reflection on the methodologies of previous approaches to empirically operationalizing the 'worldviews' concept.

3.5 The Paradigmatic Basis of Researching 'Worldviews'.

As has been described above, studies of 'worldviews' and environmental 'attitudes' have often been conducted using surveys (e.g. Dake, 1991; Rauwald & Moore, 2002; Peters & Slovic, 1996). Surveys have adopted varying degrees of open and closed-ended approaches but have perhaps most often used Lickert-type scales, frequently relying on data reduction techniques such as factor analysis and principle component analysis to try and draw out latent variables. Whilst such (quali-)quantitative approaches to investigating 'worldviews' have been popular, they are far from the only permissible methodology, and other scholars have pursued for example more interpretative approaches to empirically investigating worldviews. Using combinations of such techniques as in-depth interviews, case study, discourse and frame analysis as well as ethnographic practices such as participant observation, such approaches have typically focused on exploring how 'worldviews' may be interpreted through language.

Scholars employ these various methodological strategies in pursuit of diverse forms of knowledge. Thus resolving the question of how to methodologically pursue the study of 'worldviews', is a product of researchers' own philosophical and conceptual assumptions about what is knowable and how knowledge can be acquired. These assumptions are often referred to as the research 'paradigm'. A term generally credited to Kuhn (1996[1962]), Guba & Lincoln (1994: 105) define a 'paradigm' as, "the basic belief system or worldview that guides the investigator, not only in choices of method but in ontologically and epistemologically fundamental ways". Further to this definition, Guba & Lincoln (2005, 1994) breakdown the 'research paradigm' into the fundamental aspects of 'ontology', 'epistemology', 'axiology' and 'methodology', to illustrate that a research paradigm is defined by a given researcher's understanding of the nature of reality, ethics and knowledge and by how they believe one may go about obtaining this knowledge (Mertens, 2009).

Through this definition we can see the concept of the research 'paradigms' quickly becomes interwoven with our definition of 'worldviews'. Indeed, as referenced above, at times and in some

literatures, these terms have been used interchangeably. In this research the most salient difference in the terminology's usage can be understood thus. Through the study of 'worldviews' and their relationship to geoengineering this research seeks to expound and illuminate some of the diverse societal meanings, attitudes and expectations that people may construct in the performance of geoengineering discourse. However, as a raconteur of these 'worldviews', the research paradigm engages directly with the way in which, as a researcher, my own ontological and epistemological assumptions about the nature of research and reality become conflated within the research process. This research accordingly follows Hedlund-de Witt & Hedlund-de Witt (2015, *in press*: 6) who write that "while a paradigm tends to *define* what is valid and what [is] not for the whole of the ideological constellation of a given time and place, the worldview concept, in contrast, potentially explicates and acknowledges the existence of different viewpoints, even if they are in conflict with each other".

Researchers cannot avoid working from a research paradigm, even if they never subject it to conscious examination (Maxwell, 2008; Yin, 2009). However by making their theoretical assumptions explicit the researcher is better able to justify their research design decisions by reference to a coherent research strategy (Coll & Kalnins, 2009). An explicit research paradigm helps researchers articulate the strengths and weaknesses of their approach, and the implications of these (Maxwell, 2008). Thus through this transparency researchers are also better able to establish the parameters for evaluating the quality of their research and the basis for assessing the validity of their research findings (Shaw, 2002). Being explicit about the philosophical assumptions and theoretical frameworks employed by a researcher is therefore often described as an important research quality criterion (Onwuegbuzie & Collins, 2010). The following section of this thesis therefore seeks to illuminate the research paradigm adopted in this thesis. To ground this discussion, I begin by offering reflection on some of the paradigmatic positions common in earlier research.

3.5.1 From Positivism to Constructivism

The paradigm a researcher adopts can be as unique as the researcher themselves and paradigmatic precedents may be combined and reformulated to develop dynamic responses to research questions (Schram, 2006). There are however a number of well-established and widely recognised paradigmatic "camps" that have grown out of different philosophical and disciplinary traditions. Attempting to structure a framework of dominant research paradigms, Guba & Lincoln (1994) usefully suggest that paradigms are better conceptualized as being positioned along a spectrum, rather than as discrete and distinct entities. At the poles of this spectrum, Guba & Lincoln locate the traditions of positivism and constructivism. Positivism and constructivism have also typically

been conceptualised as the two throngs battling in the "paradigm wars" (Gage, 1989). Thus it is with these general classification typologies that this section begins.

3.5.1.1 Positivism

The assumption that the application of natural science research methods to the study of social reality is both feasible and desirable has been hegemonic within the social sciences for much of the last century. An epistemological position often attributed to 19th century Enlightenment philosopher Auguste Comte, in its staunchest form this positivist philosophy assumes that like the natural world, the social world exists 'out there', operating in a singular and lawful manner, separate from human meaning-making.

Under such an epistemology reality is divisible and fragmentable (Morgan & Smircich, 1980), apprehendable, identifiable and measureable (Ponerotto, 2005). Through rigorous application of the scientific method it is assumed that the researcher can study the participant and topic with pronounced objective detachment (Bredo & Feinberg, 1982; Guba & Lincoln, 1994; Healy & Perry, 2000; Hudson & Ozanne, 1988; Krauss, 2005) and that a 'true', 'value free' and legitimate understanding of reality can be accessed, (Ford, 1975; Hempel, 1935; Robson, 2011). Other matters, relating to aesthetic or moral significance, are meanwhile seen to fall outside of the realm of legitimate scientific inquiry (Guba & Lincoln, 1994).

The positivist paradigm generally involves adherence to a fixed and definitive research protocol with systematic quantitative methods of direct observation, which seek to maximize the positivist research quality criteria of reliability and generalizability, and which maximize the researchers ability to form predictive universal laws through empirical regularity (Campbell & Stanley, 1963; Denzin & Lincoln, 1994; Hudson & Ozanne, 1988; Robson 2011). Such a strategy is compatible with the positivist focus on hypothesis testing, wherein knowledge is generated from proving or disproving hypotheses, which are then accepted as facts or laws (Kirkpatrick et al., 1978).

3.5.1.2 A Departure from Positivism

Experiments executed through fixed research designs, which focus on proving or disproving hypotheses, are still considered by many to be the gold standard of social research (Robson, 2011). However strict positivism is commonly held to be discredited as a viable philosophy for social research (Bate, 2011; Brown, 2010; Byrne, 1998; Robson, 2011). The reasons for this are numerous and complex. Firstly, there is rising acceptance that even knowledge obtained through positivist social research cannot be detached from the assumptions underpinning it and from the methods through which is was gained (Oliver, 1992). The positivist notion of researchers as 'detached', 'neutral' observers has been particularly shunned. Instead emerging orthodoxy denotes that the

researcher and researched cannot be isolated from their personal identities (Robson, 2011; Sarantakos, 1998; Wynne, 1992) and that researchers cannot study research participants without influencing, or being influenced by them (Lee, 2000; McCall & Simmons, 1969).

Heirs to the positivist paradigm, scholars in the post-positivist tradition of social research have responded to these critiques by shifting the rhetoric of certainty to probability, and by emphasizing that reality is always imperfectly known and that knowledge is fallible and open to revision. However post-positivist scholarship still exhibits a continuing commitment to objectivity and aspires to identifying an external 'truth'. As such research design is 'fixed' early in the process and measurement and quantification remain at the heart of knowledge acquisition (Mertens, 2009). Constructivist thought meanwhile generally has both established and responded to this critique by denoting a dramatic departure from (post-)positivist praxis and nurturing very different methodological and philosophical approaches to research.

3.5.1.3 Constructivism

A paradigmatic philosophy operating under many names[22], 'constructivism' is a useful choice of terminology in that it highlights the central tenant of the approach; the belief that social phenomena and their meanings are socially constructed, being continually performed and revised by social actors[23] (Robson, 2011). With roots in phenomenology and hermeneutics, the constructivist paradigm understands knowledge to be fundamentally interpretative (Robson, 2011). Under such a paradigm, as was described in reference to an upper-case interpretation of 'Geoengineering', 'Climate Change' (Hulme, 2009) and 'Nature' (see section 2.4.1), 'Worldviews' too must be understood as constructed. They do not exist 'out there' as defined physical phenomena, whose properties can be studied using the 'objective' tools of science. Rather they are ideas that gain and retain meanings as they are constructed and performed in language (see Hulme, 2009: 327-328).

Constructivist paradigms hold that there is not one true reality that can be objectively captured and described, and it is understood that researchers do not all perceive one same reality. Instead the reality people do 'see' is determined not just by the characteristics of the thing they are observing, but also by their own personal perceptions and characteristics (Sarantakos, 1998). Constructivist

[22] See Tesch, (1990) for a list of 26 labels associated with this paradigm.

[23] At its most extreme constructivism contests the very existence of an external reality, independent of human consciousness. Reality is constructed and science is only one cultural tradition among the different meanings that humans may attach to the world. Since reality cannot be objectively measured or described, quantitative measurements cannot capture the true meaning of the phenomena being studied. Instead they serve to construct an artificial representation of the social world that further distances research outputs from participants' lived experience. Extreme relativism is rarely given more credence in social research than extreme positivism. However in what has been described as the "cultural turn" (Eden et al., 2005) a Kantian form of constructivism – a paradigm that while not denying the existence of an external reality, implicates the human mind in the process of meaning-making and attests that humans can only know this reality in a constructed form has featured heavily in human geography for much of the last 20 years.

thought has therefore been used to resist positivist accounts of 'objective' knowledge on the grounds that such narratives seek 'supreme cognitive authority' and thus are inherently undemocratic. Instead emancipatory tenants of constructivism attest that research is never an objective and value free endeavor and call for reflexivity in its application (Kelman, 1968; Kitchen & Hubbart, 1999; Robson, 2011).

Constructivists find the positivist belief that the world can be studied objectively, and without concern for how people create meaning, to be inherently reductionist (Dobson, 2002). "Human behaviour, unlike that of physical objects, cannot be understood without reference to the meanings and purposes attached by human actors to their activities" Guba & Lincoln (1994: 106) write, reflecting the constructivist commitment that social phenomena cannot be studied in isolation from their physical and social context, human meaning and purpose (Guba & Lincoln, 1994; Hudson & Ozanne, 1988; Verschuren, 2001). Thus rather than seeking an uncomplicated view of causation, and positioning values as confounding factors with no place in scientific inquiry, constructivist research seeks to understand the meanings attached to events or phenomena.

Statistically derived abstractions may have little meaning within contexts studied (Guba & Lincoln, 1994). Hence constructivist methodologies typically employ qualitative research techniques which elicit "richer", "thick description" data (Geertz, 2000[1973]). Whilst this is not as easily generalized (Berger et al., 1982), the ambition of such a strategy is to generate a deeper understanding of the multiple perspectives and meanings that may become attached to a given research subject (Bryman, 2006; Denzin, 1984; Robson, 2011). For this same reason constructivist paradigms generally adopt approaches that attempt to understand the world from the perspective of those who they are researching (Denzin, 1984; Ponterotto, 2005). Thus the researcher becoming acquainted with their research subjects and the context in which they are situated can be viewed as an opportunity to gather additional data rather than a threat to the research. As a result constructivist research often employs more personal, interactive and at times collaborative research designs, that seek an 'insiders perspective' of the observed's "lived experience" (Denzin, 1984; Mertens, 2009; Ponterotto, 2005).

By embracing more participatory research protocols, constructivist research may permit research participants to become research partners rather than just research subjects; scientific objects which provide data (Sarantakos, 1998). Qualitative approaches typically employ more 'flexible' research designs (see Robson, 2011) that can be developed so as to allow informants the opportunity to shape the research within their own frame of reference. Building trust, respect and reciprocity between the researcher and researched (Lather 1987), such an approach can strengthen the research process by encouraging greater cooperation (Chambliss & Schutt, 2010) and potentially by taking

the research in new and more meaningful directions. Shanklin (1979: 144), for example, explains that a more flexible and participatory research strategy allowed her research to evolve and elicit information in ways, and about issues, that she would otherwise "never have known enough to ask about". Participatory research methodologies are also generally more compatible with calls for more emancipatory research that benefits those who are studied (Lather, 1987; Strauss & Corbin, 1990). Reducing for example, the potential for "othering" of research participants, this participation may be fundamental to maintaining the ethical integrity of social research: Itself fundamental to scientific rigour (Kushner, 2005; Robson, 2011).

As described by Watts & Stenner (2005: 72), constructivist researchers that pursue enquiries into 'worldviews' and 'attitudes' tend to question the very existence of the unobservable entities that positivist psychological tests and surveys set out to measure. McNamee (2004: 39) illustrates the consequence of such a commitment when she writes "knowledge and understanding are not in the person but in the *performance*. Thus, interest in constructs – a hypothetical, abstract notion – is replaced with an interest in communication, discourse, dialogue". The acknowledged relationality between the researcher and the participant is then also brought to bear on the researcher's interpretation of this discourse. The researchers' own accounts of studied phenomena are interpreted reconstructions of the meanings constructed by participants, and are thus themselves also a product of the researcher's own values and experience. Negotiating this relationality demands the researcher employ careful reflexivity about their own role and position, and the extent to which these may interact with and shape the research output (Hall & Callery, 2001; Mahony, 2013).

3.6 The Research Paradigm of this Thesis

To reiterate my research aim, using the conceptual framework of 'worldviews', this research is interested in exploring how people attach meanings to the idea of geoengineering when reaching normative conclusions about its desirability and feasibility. Recognising the substantive, instrumental and normative rationales for public participation in debates about technological pathways (see section 2.6), this research has the parallel ambition to reflexively "open up" (c.f. Stirling, 2008) the debate on geoengineering to wider ontological, epistemological and axiological perspectives and thus to resist the metaphorical 'hall of mirrors' (see section 2.4.1.1). As such it has called for a more holistic upper-case interpretation of 'Geoengineering' that recognizes multiple and competing human values in meaning making (c.f. Hulme, 2009).

To relate the words of Hulme (2011: 179), as has been argued in this chapter, (post-)positive approaches are poorly suited to engaging with and articulating such a "deeper human search for values, purpose and meaning". The multi-perspectivism of constructivist approaches meanwhile is broadly compatible with these aims. Putting the analytical focus on how individuals construct and

make sense of an issue, or on how meaning is produced when individuals interact and engage in interpretation, the constructivist researcher's goal is to elicit methodological techniques that allow them to explore not one, but multiple social constructions of meaning and knowledge (Mertens, 2009).

For these reasons this research seeks to employ a constructivist-oriented paradigm. Noting this explicitly is important since over the following chapters – as the research design is articulated and the results from my research are reported – at times an untrained eye could be forgiven for confusing this work with research that follows a pragmatic tradition. Pragmatism is a research paradigm that Tashakkori & Teddlie, (1998: 5) claim, permits a 'whatever works' strategy which, positioned within the middle-ground of the paradigm wars, enables the research to deliberately avoid polarizations around the quantitative vs qualitative, positivist vs constructionist debates, and to benefit from the strengths, and avoid the weaknesses of both approaches (Baum, 1995; Creswell, 2003; Denzin, 1970; Gage, 1989). Pragmatism therefore most visibly encourages a mixed-methodology research design, enabling the researcher to enlist the best ways to answer the research questions, unconstrained by obligations to a methodological paradigm, (Coxon, 2005; Howe, 1988; Moran-Ellis et al., 2006; Robson, 2011).

There are multiple advocates of mixed methodology research (see especially Creswell & Plano Clark, 2011; Tashakkori & Teddlie, 1998) and it has been proposed that the complexities and 'messiness' (c.f. Howitt, 2001) of socioenvironmental issues – including geoengineering (see Buck, 2014b) – can particularly benefit from mixed-method approaches. In one such appeal for methodological heterogeneity Vaccaro & Smith (2010: 4) write, "these different approaches and types of information can often be [complementary]. A research design that incorporates several of the proposed methods may be better equipped to generate a more nuanced approach to a particular issue" (Vaccaro & Smith, 2010: 4). In her study of 'worldviews', Hedlund-de Witt (2013a: 286-287) is similarly guided by a conviction that highly complex, intangible and elastic phenomena like 'worldviews' that manifest in a variety of different ways are "more likely to be adequately understood through bringing together different theoretical and disciplinary perspectives" that allow for "eclecticism and pluralism".

The research design adopted in this research is similarly premised around the understanding that since every method has its own limitations (Kagan, 2009), opening the doors to alternative methodological structures can permit new and innovative research possibilities and a more complex understanding of social engagements with geoengineering. However, as will be outlined in chapter 4, this research remains persistently grounded in interpretative discourse analysis that explores how language can be used to access new understandings of human and personal meaning-making about

geoengineering. It thus maintains a stronger constructivist commitment than is typical of pragmatist researchers. Flexibility of methodological approach within a coherent paradigmatic view of the topic has however permitted the use of Q-methodology to structure an interpretation of the way in which different 'ecological' ontological, epistemological and axiological commitments are shared and configured within the geoengineering debate.

Q-Methodology is a 'qualiquantological' (Stenner & Stainton Rogers, 2004) research method that with roots in correlation statistics and an inverted variant of factor analysis aims to structure the identification and comparison of key shared and contested 'points of view' that surround a given issue or topic (Coogan & Herrington, 2011). However social constructivism has formed the basis of one of the most popular and sustained theoretical adaptations of Q-methodology (Watts & Stenner, 2012). Thus the form of Q-methodology adopted in this thesis remains grounded in interpretative discourse analysis, and the statistical processing of the Q-sort is merely used to facilitate and bolster the qualitative interpretation.

3.7 Application of the Integrative Worldviews Framework to the Study of Nature and Human Agency in Discourse on the Desirability and Feasibility of Geoengineering

Provided the concept is not reified as if it described a tangible and concrete entity, the idea of 'worldviews', as articulated by Hedlund-de Witt (2013a, 2013b, 2013c, 2012; Hedlund-de Witt & Hedlund-de Witt, 2015, *in press*), is in many ways deeply compatible with a constructivist paradigm. Seeking to reveal the ways in which divergent theories of the world are constructed and to explore societal values, meanings, attitudes and expectations, as Hedlund-de Witt (2013c: 154) writes, the concept "invites a *profound reflexivity—a* reflexivity not only flowing forth from the acknowledgment of the existence of multiple worldviews and (thus) their cultural-historical and personal-idiosyncratically constituted natures, but also from a perspective on reality itself as *brought into being through participation,* that is, reality as fundamentally enactive and co-creative". Koltko-Rivera, (2004: 8) is likewise making a similar point when he writes, worldviews are "inherently postmodern".

The comprehensive and systematic nature of the IWF framework simultaneously makes it a valuable tool for structuring an interpretative exploration of worldviews. However in its current form, its remit does not completely align with the study research aims. This research is specifically interested in exploring how geoengineering discourse is shaped by and emerges from diverse ontological, epistemological and axiological commitments to ideas of 'nature' and the role of human agency. The collection of beliefs that a person holds towards the environment forms an integral part of Hedlund-de Witt's 'worldviews' construct. However not all 'worldviews' are 'ecological', or pertain to the human relationship with the natural world. One could therefore argue that the phenomena of interest to this study could be similarly explored through a diverse range of

alternate linguistic framings: 'Nature-imaginaries', 'ecological knowledges', 'environmental attitudes', 'general environmental beliefs'. I have however opted to conceptualise this as a study of how 'worldviews' interact with geoengineering, since I believe that doing so may help explicate the holism and illimitableness inherent to attitudes towards nature that is fundamental to implementing an encompassing and 'grounded' operationalization of the research questions.

To briefly elaborate, as Castree (2005: xix) writes, semantically speaking "the concept of nature knows no bounds" and the notion of worldviews in the IWF is designed to be similarly as encompassing. Such a strategy accordingly does not impose a pre-determined analytical lens that focuses the remit of research on particular given aspects or constructs of environmental attitudes (as denoted by the approaches reviewed in section 3.4). Instead the IWF facilitates and indeed invites an inductive approach to analysis that allows the researcher to explore and respond to those features of the discourse that emerge as being most salient and illuminating to the research questions. This makes the IWF compatible with the more 'grounded' approach to analysis that will be outlined in section 4.2.4.1. The language of 'worldviews' is also preferable since it is less privileging than, for example, that of 'knowledges'. In order to specify the particular analytical lens bequeathed through the research questions, Hedlund-de Witt's nomenclature is however adapted to specify a particular interest in the interface between geoengineering and '*ecological* worldviews'.

The particular methodological strategies for using the IWF as an interpretative lens to scrutinize and code the data will be detailed in chapter 4. It is nonetheless worth at this stage clarifying the IWF's role in this research. As discussed in section 3.4.3 Hedlund-de Witt designed the five distinct but interrelated aspects of the IWF framework – as well as the exemplary questions described for each aspect (see Figure 3.2) – to organize and systematize the process of explicating different worldview beliefs. The IWF therefore serves as an orienting heuristic framework for structuring an investigation and analysis of the way in which different voices and position are constructed in geoengineering debates vis-à-vis nature.

The research does not however set out to evaluate the effectiveness of Hedlund-de Witt's own classification typologies through which she aims to describe the general contours of predominant 'worldviews' of the West through the labels of 'traditional', 'modern', 'post-modern' and 'integrative' (see section 3.4.3.1). Hedlund-de Witt has a made a convincing argument for the salience of these typologies (see e.g. Hedlund- de Witt, 2013a, Hedlund- de Witt & Hedlund- de Witt, 2015). However in the spirit of grounded theory (see section 4.2.4.1) the research seeks to remains open-ended and explorative, leaving the researcher freer to respond to salient features that emerge from the data. This commitment to an inductive research design and recognition of the

diversity inherent to expressions of 'worldview' precludes this author from seeking to rely too heavily on ideal-typical representations of 'worldview beliefs'.

3.8 Exploring Ecological Worldviews through the Case of the Haida Salmon Restoration Corporation

This chapter has posited the need for an open, interpretative and inclusive approach to exploring ecological ontological, epistemological and axiological assumptions in human meaning making about geoengineering. Accessing a deeper understanding of multiple perspectives and meanings has been argued to necessitate a more 'flexible' (Robson, 2011: 45) research design, through which the researcher seeks to understand the meanings attached to events or phenomena from the perspective of those they are researching. Section 2.9 additionally attested to the value of a geographical perspective, arguing that its disciplinary preoccupation with place offers geography a unique lens from which to explore how wider cultural meanings of nature and human identity may play into geoengineering meaning-making.

These criteria however presented notable logistical challenges, and thus in the early stages of my PhD research I spent considerable time deliberating over how to design research that would permit this more immersive and flexible engagement with human meaning-making on geoengineering. Sophisticated in-depth deliberative approaches have become the gold standard of public consultation on geoengineering (Bellamy, et al., 2014; Macnaghten & Szerszynski, 2013). However because participants' in these processes typically don't have much advance understanding of geoengineering, these research designs still in some sense have to create the views that they seek to elicit (Buck, 2010; Stirling, 2008). The potential for such settings to account for place, and thus to take the researcher into the realms of immersive 'real world' enquiry (c.f. Robson, 2011: 4), therefore remains more limited.

Adopting a more imaginative notion of 'place' (see section 3.8.1 below) – the potential for such an immersive study appeared to be more readily feasible within academic and specialist domains, where more established debate is visible. Subsequently in the early stages of this research I considered the possibility of undertaking research in such organizations, fora and 'communities' as the IPCC, the Royal Society and the Geoengineering Google Group. The discourse, events and actors prominent to the 'SPICE' project was also considered as a potential case study allegory.

In October 2012 however, in an article headlined "World's biggest geoengineering experiment 'violates' UN rules", the *Guardian* newspaper broke news of the Haida Salmon Restoration Corporation's (HSRC) ocean fertilization experiment. The subsequent reporting revealed that in July 2012 the Vancouver-based HSRC had dispersed 100 tons of iron sulphate and 20 tons of iron

oxide into the Pacific Ocean, 370 kilometres off the coast of the British Columbian archipelago of Haida Gwaii. The corporation was financed by the Haida village of Old Massett, on the promise that the project that would revive depleted local salmon runs, while providing a meaningful response to the threat of anthropogenic climate change and generating millions of dollars from the sale of carbon credits.

The HSRC was deeply divisive in Haida Gwaii (and elsewhere) and provoked strong, emotional reactions in resistance to, as well as in support of, the project. A rare site of live public debate about the desirability and feasibility of – at the very least – ocean fertilization forms of geoengineering ensued. Thus the Haida Salmon Restoration Corporation presented a unique opportunity to explore a 'real world' case of geoengineering, diversely experienced and interpreted by varied 'lay' and 'expert' actors and commentators. With research on public perceptions of geoengineering previously dependent upon more abstract rationality, the HSRC experiment, anchored in notions of place and identity, marked a novel entry point into thinking about social research on geoengineering and appeared to offer the opportunity to pursue a more situated engagement with geoengineering, in keeping with geographical traditions. The HSRC experiment was accordingly adopted as a distinctively opportunistic case study.

3.8.1 The Haida Salmon Restoration Corporation: 'Geoengineering' "by People in a Place"

As Buck (2014b) argues, and as will be illustrated in this thesis, reactions to the 'geoengineering' activities of the HSRC project in Haida Gwaii were shaped by local and global socio-ecological concerns and by local debates about natural resource use and access. The constructivist commitment that social phenomena cannot be studied in isolation from their physical and social context, human meaning and purpose therefore demands that the HSRC be understood as a project conducted "by people in a place" (Buck, 2014a).

To copy the language of Smith (2013: 155) such a commitment to place suggests that to answer the research questions this research must engage with "local dialects of nature" which, in the context of restoration discourses, she understands to be embedded within social context, site specificities and attachments to the landscape. Importantly Smith (2013) highlights that the concepts of place and site are important to accessing such "local dialects of nature", as they address issues of scale and position 'nature' within wider cultural landscapes.

Such concepts of place and site may initially appear obvious and common-sense (Creswell, 2004). Yet while a site may appear bound by socio-cultural, geo-political and historical context, it cannot be understood as a demarcated and predefined geographical space in uncomplicated terms. Local meanings, practices and identities do not exist in isolation, rather they are multiply produced and

intricately interwoven into the broader fabric of the social world (Tsing, 2004). Technological revolutions in communication and transport in particular have lead some to argue that the usefulness of place as a geographical, sociological and anthropological concept is gradually eroding (Creswell, 2004; Lewicka, 2011; Gieryn, 2000).

This thesis will visibly illustrate how discourse of the HSRC traverses spatial and temporal domains, dissolving different theoretical boundaries[24]. So could it just be, as Gieryn (2000: 463) asks, that place just does not matter anymore? Geographers still think that it does (Creswell, 2004). However such critical introspection has lead to the need to reevaluate the norms, convictions and practices that are brought to the study of places.

3.8.1.1 A 'Cosmopolitan' Approach to Place

To help researchers appreciate such multiplicities and interrelatedness of global people, knowledges and places, Beck (2007) has called for a cosmopolitan perspective in research. "The world has not become borderless" Beck writes, "but the boundaries are becoming blurred and indistinct… This alters the conditions for the construction of social identity, which need no longer be impressed by the negative juxtaposition of 'us' and 'them'". Shaped by the intellectual capital of constructivist thought and devised as a response to these instrumental changes in modern world cultures and systems, cosmopolitanism it is argued can open up new research possibilities by permitting the empirical investigation of entangled and heterogeneous phenomena that manifest, transverse and mutate across different sites and places (Beck & Sznaider, 2010)[25].

By situating the 'local' within the 'global' (Hulme, 2010b) Thomas Gieryn (2000: 464-465) accommodates such cosmopolitanism in his definition of place, whilst permitting place to maintain its own experiences and histories. "A place is a unique spot in the universe" he writes. "Place is the distinction between here and there, and it is what allows people to appreciate near and far. Places have finitude, but they nest logically because the boundaries are (analytically and phenomenologically) elastic… place is not space – which is more properly conceived as abstract geometries (distance, direction, size, shape, volume) detached from material form and cultural interpretation… Put positively, place is space filled up by people, practices, objects, and representations".

[24] To offer just a couple of examples, as will be discussed in chapter 5, people, experiences and entities situated 'on the ground' in Haida Gwaii can be seen shaping global media discourse (albeit through a limited set of framings). Conversely familiar globally salient discourses and processes were reintegrated into local meaning and echoed during interviews in Haida Gwaii: Interview participants for example regularly referred to media reports and scientific findings during interviews, both to help articulate and to justify their own perspectives on the experiment and on geoengineering and climate change more broadly.

[25] In climate change research Hulme (2010b) has similarly argued that a cosmopolitan perspective may help us understand the way people experience weather and climate in an ever more connected world.

3.8.2 Constructing The Haida Salmon Restoration Corporation Case Study as a Cosmopolitan Field-Site

Gieryn's understanding that culturally produced images of places are always constructed is liberating for a researcher who must in some way bound the remit of their research in a field-site. Understood in these terms field-sites need not be constrained and compartmentalised through 'objective' indicators that set an artificial limit on the scope of the study (Amit, 2000). Instead a cosmopolitan perspective demands a more holistic approach to construction of the field-site, expanding the analytical focus to enable linkages between ideas, discourses, people, places and practices to be explored across various sociocultural scales. This more holistic approach to constructing the field is appealing given the study's ambition to situate the study of ecological 'worldviews' within their social and cultural context. And by leaving space to explore how meanings are produced when individuals interact and engage, a more flexible approach to defining the research field-site only further embraces the multi-perspectivism of constructivist approaches.

3.8.2.1 A (Somewhat) Multi-Sited Field

So how can a more mobile and less bounded field-site be operationalized? Section 4.2 will argue the merits of approaching the case study of the HSRC ethnographically. In brief an ethnographic approach is compatible with the research aims and paradigm since it is typically characterized by an ambition to enter the researched social worlds, emotionally and mentally (Robson, 2011; Scott Jones, 2010a). Ethnographers focus on contextualizing their research by means of "thick description" that facilitates 'understanding' in a phenomenological sense. Further ethnographers are comfortable with a flexible approach to research design, that permits emergence, and an inductive approach to analysis that avoids early use of theories and concepts (Bryman, 2006). I mention ethnography here since recent iterations provide inspiration salient to the challenge of constructing the parameters of a field-site.

Ethnographers have in recent years particularly embraced the opportunity to expand research horizons from single-site locations to more complex objects of study (Marcus, 1995; Tsing, 2004). Such 'multi-sited' ethnography does not necessarily entail research in different geographical locations, but rather it is methodologically structured to permit the study of a given phenomena from different perspectives and to account for the lived experience of phenomena by transecting scalar diversity in knowledge production (Crate, 2011). Such a demand to work across these multiple scales, crosscutting such dichotomies as the 'local' and the 'global', has encouraged ethnographers to construct field-sites in more novel domains, such as for example among academic peer networks and through web-based forms of communication such as forums (Ellis & Waterton, 2005; Hine, 2007).

This mode of ethnography can be employed in a fairly open-ended manner, allowing the study field-site to evolve during the research process. Therefore as Marcus (1998: 90) explains, the techniques through which multi-sited ethnographies are able to define their objects of study might be understood as "practices of construction through (preplanned or opportunistic) movement and of tracing within different settings of a complex cultural phenomenon given an initial, baseline conceptual identity that turns out to be contingent and malleable as one traces it".

Field-sites are always constructed. However in such 'multi-sited' ethnographies the researcher is rendered an even more central agent in the construction of the field (Amit, 2000). Whilst requiring additional reflexivity, in keeping with constructivist thought researchers performing such an active and purposeful role in constructing the field-site is viewed as an opportunity to devise a more purposeful research design and gather more meaningful data, rather than as a threat to the research[26]. As Hine (2007: 656) explains, for example, multi-sited ethnography may offer "the possibility of crafting a research object specifically designed to engage in a particular argument, or to be significant to an identified context of concern".

This study is not obviously multi-sited in a conventional sense, since novelty in this research lies in the HSRC being anchored in notions of place and identity. Through this site I sought to explore lived experience of the HSRC project, exploring reactions to the project performed through the discourse of members of the HSRC and among inhabitants in the geographical locality of Haida Gwaii. Yet with contestation about the project visible across various sociocultural scales, the HSRC project is a moving story. Thus in keeping with Gieryn's (2000) definition of place, while remaining grounded in local and visceral experience and context, I took inspiration from the approaches of multi-sited ethnographers and did not seek to reify the boundaries of the case study. Instead, with the field-site designed to engage with the identified context of concern (c.f. Hine, 2007), the people, ideas, discourses, forms of knowledge and practices that surround the HSRC project were all of interest.

3.8.2.2 Follow the Conflict, Plot, Story or Allegory of the Haida Salmon Restoration Corporation

Multi-sited research is typically "designed around chains, paths, threads, conjunctions or juxtapositions" (Marcus, 1995: 105). Tracking strategies that involve following connections, associations, divergences and perceived relationships have therefore been at the heart of multi-sited ethnographies (*ibid*). Hoping to offer methodological clarity to these more novel forms of mobile ethnography, Marcus (1995) proposed a number of such tracking strategies, among which he suggests that a researcher may "follow the plot, story or allegory" or "follow the conflict" when constructing and defining objects of study within a multi-sited space.

[26] An evolving field-site additionally opens the door to the possibility of more collaborative research designs that are responsive to participants' input, and thus shape the research within their own frame of reference.

In some ways reflective of Anna Tsing's (2004: xi) "zones of awkward engagement", employed together the "follow the plot, story or allegory" and "follow the conflict" strategies both served as useful heuristics for defining the field-site. By encouraging the pursuit of multiple social accounts of the HSRC project, traversing diverse paths, conjunctions and associations, these strategies permitted the exploration of how different meanings can be discerned in diverse encounters and interactions[27]. While not all dimensions of the fieldsite were studied with the same intensity, I was therefore left free to traverse discourses, people, places and practices that surround the HSRC project at various sociocultural scales.

3.8.3 Exploring Perceptions of Geoengineering through a Case of Ocean Fertilization

This research pursues a case study of an ocean fertilization project, which is only one form of many existent and speculative technologies that have been associated with the 'geoengineering' taxonomy. Robock (2008) notes that SRM and CDR geoengineering technologies have very different philosophical, ethical, legal and governance profiles. Others have emphasized that these profiles are also diverse at the level of individual technologies and that different technologies exhibit different technical characteristics, as well as different potential distributions of risks, burdens, benefits and potential side-effects (Hulme, 2014; Royal Society, 2009; Vaughan & Lenton, 2011). Deliberative work has similarly reported different public responses to different geoengineering technologies (e.g. Bellamy et al., 2014).

It could appear then that exploring perceptions of geoengineering through a case study of an ocean fertilization project might be very limiting. And one could argue that this case of ocean fertilization, done "by people in a place" (Buck, 2014a) may tell us very little about ecological ontological, epistemological and axiological assumptions that shape meaning making about 'geoengineering' writ large. This is in fact a common critique of case study research: Scholars have widely assumed that case studies provide little basis for scientific generalization (Bromley, 1986; Flyvbjerg, 2006; Yin, 2009). Such an assumption is not strictly defensible, since there are instances where case studies do offer the potential for generalization (Flyvbjerg, 2006). Indeed even when statistical generalization to enumerate frequencies among wider populations is not possible, it may be feasible to generalize theoretical propositions from a case study (Flyvbjerg, 2006; Yin, 2009). Different research strategies do however have different strengths and weaknesses, and focusing too heavily on generalization overlooks the value of case study research as a distinctive form of empirical enquiry.

[27] To offer an example of how this manifested in the research sampling strategy, global media discourse of the HSRC cited by research participants in Haida Gwaii was incorporated into the corpus of data and subjected to discourse analysis. Similarly by encouraging the lens of comparison, following "the conflict" usefully helped to tease out commonalities and differences in the construction of meaning, discourses, identities, epistemes and representations could have been otherwise overlooked.

As Flyvbjerg (2006: 227) writes, "that knowledge cannot be generalized does not mean that it cannot enter into the collective process of knowledge accumulation in the field". Indeed even a purely descriptive case study can prove inspiring and insightful (Thomas, 2011). The decision to employ a case study often comes from a line of reasoning that attests that with certain research questions we are better learning from a specific example (Thomas, 2011). Hans Eysenck (1976: 9) reflected such a perspective when he wrote "sometimes we simply have to keep our eyes open and look carefully at individual cases – not in the hope of proving anything, but rather in the hope of learning something". Generalization is therefore not always the ambition of a researcher and it is certainly not the only means by which researchers can gain knowledge.

Sitting comfortably within the constructivist research paradigm, which emphasizes exploring social phenomena within their physical and social context, (see section 3.5.1), instead case studies involve developing detailed knowledge about a defined case. As Stake, (2005: 10) described, case study research is particularly good at depth and 'particularization'. Case studies can offer a rich picture, with insights obtained from diverse angles, from diverse sources of evidence (Thomas, 2011; Yin, 2009). Case studies avoid abstraction and allow researchers the opportunity to retain meaningful characteristics of real life circumstances (Yin, 2009). Thus they lend themselves to research questions that hope to understand complex social phenomena within their real-life context.

For these reasons, generalization is not the intended purpose of this research. Yet by coincidence, the profile of ocean fertilization as a geoengineering strategy exhibits a couple of characteristics that *may* mean that this particular case study has some opportunity to analytically generalize theoretical propositions about contested ecological ontological, epistemological and axiological assumptions in wider geoengineering discourse. Some of these potential linkages are tenuous, but warrant brief reflection.

Ocean fertilization has been classed as a carbon dioxide removal technology (Royal Society, 2009). The fundamental premise behind the CDR/SRM distinction is that CDR aims to treat the cause of climate change, (the overall concentration of atmospheric greenhouse gas) rather than the symptom (anthropogenic global warming and its associated climate impacts), (see Heyward, 2013; Science and Technology Committee, 2010; Stilgoe, 2015). For this reason CDR geoengineering has at times been favourably compared with mitigation (Heyward, 2013), while SRM technologies have been criticized as "imperfect" solutions (Morgan & Ricke, 2010: 5). As noted by Clingerman (2014: 9) for example, "SRM also does not alleviate the problems of increased carbon dioxide in the atmosphere, meaning that these proposals are more technologically invasive and also do not mitigate for things such as changes in plant growth, the effect of carbon dioxide on the oceans, and the like". Understood in these terms ocean fertilization may take on an almost 'naturalising' rhetoric, wherein

carbon dioxide removal is understood to actually help restore the climate system to its prior state.

Geoengineering technologies have however been disaggregated into subclasses based on numerous attributes and the SRM/CDR distinction encompasses only a limited range of these attributes. Other attributes used to divide geoengineering technologies into different subclasses include distinctions between encapsulated and unencapsulated technologies, the systems that geoengineering proposals would affect, the scale of their application and whether or not they operate beyond sovereign state boundaries. Equally the Asilomar Scientific Organising Committee (2010) made an attempt to divide geoengineering proposals into 'remediation' and 'intervention' technologies, perhaps suggesting that some technologies are, in effect, more advertent, involving embarkation into a new project of techno-mastery through which humanity not only seeks to reverse human impact, but pursues a more direct route to a 'planetary thermostat' (Hulme, 2014). For the Asilomar Scientific Organising Committee these categories were broadly synonymous with the CDR/SRM distinction. However interpretations of these distinctions are malleable and one could reasonably argue that in some respects ocean fertilization could be seen as similarly 'interventionist', 'unencapsulated' and 'advertent'.

In this vein, many of the major philosophical and technical concerns that have typically been raised in the context of such SRM proposals as injecting sulphate aerosols into the stratosphere, have also been raised in respect of ocean fertilization. Like sulphate aerosol injection, if deployed at scale ocean fertilization would for example also involve direct intervention into the chemical composition of a large-scale dynamic and chaotic ecological system. Thus some commentators have drawn parallels between changing the composition of an uncontained and dynamic oceanic system, and changing the composition of an uncontained and dynamic atmospheric system; suggesting that each intervention may result in transboundary consequences that would be similarly, if not equally, difficult to control and predict[28]. The intended effects of both ocean fertilization and sulphate aerosols may only become apparent over long timescales and given the probabilistic nature of inquiry some have attested that "deployment will… always have the character of research" (Szerszynski et al., 2013: 2811).

The idea that through ocean fertilization, "the seas could be tended on a large scale by human shepherds" invokes rhetoric of hubris familiar to contestation about other geoengineering technologies (Buck, 2014a: 6). The appearance of such rhetoric in relation to the HSRC will be explored in section 6.3. However to offer a brief illustration, in this vein, like sulphate aerosol

[28] Such a view was reflected by Matt Watson (in NPR, 2013) who wrote, "A better way to categorize the technologies might be whether or not they have a local or a global scale. Things like painting roofs white or planting trees, they might be seen to be done on a local scale; whereas actually things like volcanic aerosols and ocean fertilization, they act on your atmosphere, my atmosphere, the people in Bangladesh's atmosphere. And they're much less controllable because they have a global effect".

injection, ocean fertilization has similarly been cast as offering a route to a kind of potential global thermostat. "Give me a half tanker of iron and I will give you an ice age", quipped oceanographer John Martin" (in Garrison, 2010: 390).

These varying interpretations of ocean fertilization leave space for contestation around heuristics such as 'naturalness' and the role of human agency to play out within the HSRC case study of ocean fertilization. Whilst this discourse is unlikely to be analogous with other geoengineering technologies, given some of the characteristics that ocean fertilization shares with other geoengineering proposals, this debate may well offer some insight into some wider theoretical propositions about contested ecological ontological, epistemological and axiological assumptions about the role of geoengineering. This claim is not dissimilar to that made by Corner et al. (2013: 940) when they write that "geoengineering proposals are likely to act as a catalyst for wider societal debates that reflect much more than simply an evaluation of the physical risks or benefits a particular technology may possess".

Chapter 4: Methodology

4.1 Introducing the Research Methodology

"'Methodology' refers to the process and procedures of the research" (Ponterotto, 2005: 132) and flows from the research paradigm detailed in chapter 3. By now I have clearly established the aim of this research: To explore how people make sense of the 'geoengineering' activities of the HSRC through the construction of diverse ecological ontological, epistemological and axiological assumptions about the role and nature of 'Nature[29]' and human agency. The conceptual and analytical frameworks of the research have also been detailed. The goal of this chapter is therefore to summarize the methodological techniques employed in this study, that allowed me to action these frameworks into an exploration of some of the multiple salient constructions of meaning that surround the HSRC case study.

As a constructivist researcher, this research remains consistently grounded in interpretative approaches to exploring the performance and construction of human meaning-making on geoengineering; inter alia the meaning of nature, the meaning of the human condition and the changing and desirable relationship between humans and nature. In the preceding chapters I have argued for the need to pursue a holistic, open, inclusive and flexible approach to exploring this object of study. 'Worldviews' are complex, intangible and elastic constructions thus, following Hedlund-de Witt (e.g. 2013a, Hedlund-de Witt & Hedlund-de Witt, 2015, *in press*) I have suggested that different routes of enquiry may generate different complementary insights. Within a coherent paradigmatic view of the topic, the methodology is therefore designed to incorporate multiple sources of data and to be flexible enough to allow me to respond to interesting lines of inquiry as they emerged.

4.1.1 The Two Methodological Phases of the Research Design and The Relationship Between The Two Phases of the Research Design

As illustrated in the research schema offered at the start of this thesis (Figure 1.1), the research is structured around two related, but distinct, phases. Phase one of the research particularly seeks to embrace this open and flexible approach to case study data collection and, during a prolonged period of time immersed in the field setting, pursues multiple lines of ethnographic qualitative enquiry. These include combinations of such techniques as participant observation, interviews of varying depth and formality, media and text analysis, and a focus group.

The empirical output of this phase of the research is reported in chapters 5 and 6. Chapter 6 offers an interpretation of the key ways in which individuals and texts frame the 'geoengineering' activities

[29] Capitalized to reiterate the upper-case interpretation of nature discussed in section 2.4.1.

of the HSRC. This stage of analysis is notably based on emerging themes and allows for an initial drawing together of ideas and meanings following interrogation of the discourse. In keeping with the constructivist commitment that social phenomena cannot be studied in isolation from their physical and social context, human meaning and purpose (see section 3.5.1.3), chapter 5 meanwhile aims to situate this meaning-making within local experiences, histories and place.

Through the use of Q-methodology, phase two of the research further structures the interpretation offered in chapter 6 of how discourse around the HSRC invokes diverse ecological worldview assumptions. This second phase of the research pays homage to the characterization of worldviews as "overarching systems of meaning-making" (Hedlund-de Witt, 2012: 80) (see section 3.3). It does this because unlike the more conventional forms of qualitative discourse analysis employed in phase one of the research, Q-methodology does not explore data at the level of component themes, but rather aims to explore 'ideal-typical' viewpoints constructed by the Q-factors as gestalt entities (Watts & Stenner, 2005a).

The design of this thesis is sequential and phase two of the research builds on the findings of the previous methodological phase. The sequenced relationship between the two phases is most visible in the development of the Q-set: The set of statements that participants sort to best reflect their own perspective on exploring ocean fertilization as a means of sequestering carbon dioxide in the ocean. In this research the Q-statement concourse was developed as an output of the interpretative frame analysis explored in chapter 6. In a sense the Q-sort therefore also offered a subset of participants the opportunity to member-check (Long & Johnson, 2000) and to comment on some of the results of the interpretative ethnographic analysis. Feedback on the Q-set therefore also offered some further insight into the 'credibility' (c.f. Finlay, 2006) of the interpretations offered in phase one of the analysis.

Like more conventional forms of factor analysis, Q-methodology is in essence a form of data reduction that seeks to categorize and draw typologies from the collected data. In some ways this stage of the study could therefore fall foul of the critiques held against previous psychometric and Cultural Theory approaches to exploring worldviews; notably that the technique inherently further abstracts and constrains socio-cultural relativism, pursuing order and simplicity at the expense of nuance and diversity (see sections 3.4.1.2 and 3.4.2.1). The two-phase design of this research is however felt to go some way towards rebutting this critique, since the first phase of the research maintains a more open, grounded, analytic approach, that is more able to respond to salient features of the discourse without immediately attempting to 'fit' the data into potentially artificial boxes.

The value of additionally pursuing this second seemingly more overtly reductionist phase of Q-methodology analysis has however been convincingly attested by Cultural Theory scholar Mary Douglas. In her 1982 *Essays on the Sociology of Perception*, Douglas argues that people inevitably employ typologies; they categorise in order to comprehend, making these categories unavoidable in the progress of cognition. Eschewing explicit typologies is therefore "to expose the whole domain to undeclared implicit typologies", she writes (Douglas, 2003[1982]: 2). For Douglas, providing the limitations of such representations are acknowledged, making categories explicit can therefore allow researchers to generate meaningful heuristic insight into the seeming chaos of social reality, whilst allowing these typologies to be treated reflexively and improved upon. This does not mean the resulting Q-factors should be understood in any kind of absolute or unconditional way, but rather they can serve as heuristics, that while configured diversely in individuals' meaning-making, can help further structure an interpretation of where key commonalities and differences between perspectives lie.

4.2 Phase One of the Research: Interpretative Ethnographically Informed Qualitative Enquiry

Ethnography is widely used in social research and is very much a style or 'sensibility' of research, rather than a prescriptive method or research procedure (Robson, 2011; Scott Jones, 2010a). A defining feature of ethnography is that ethnographers seek, as far as possible, to become immersed in a study field setting, over an extended period of time and to gain an 'insiders-perspective' on the people or social phenomena being studied. Typically this involves a degree of participation in these social worlds on different physical, social, emotional and mental levels (Okely, 1992; Robson, 2011). Ethnographers seek to contextualize their research within spaces and identities, contexts and histories. Thus effort is made to view the phenomena of interest as part of the wider social processes in which they are situated (Bryman, 2006).

Participant observation is the research method most commonly associated with ethnography, however ethnographic research generally pursues multiple lines of empirical enquiry (Davis, 1999). Ethnographic research techniques are generally qualitative and prioritise depth and detail (Bryman, 2006; Scott Jones, 2010a). An unstructured, 'flexible' (Robson, 2011: 45) research design that permits emergence is also typical of ethnographic research and an open-ended approach is normally employed, which avoids the early application of theories and concepts (Bryman, 2006; Hammersley & Atkinson, 2007). In more recent years, ethnography has evolved to permit ethnographic engagement in a wider and more novel range of social and cultural settings (e.g. Amit, 2000) and whilst ethnographic research has been typically characterized by researchers pursuing many years immersion in the field context, more recently ethnographies of much shorter duration have been conducted (Amit, 2000).

In this research, techniques including media frame analysis, participant observation, in-depth interviews, a focus group, and analysis of other texts and local media coverage were pursued. However, before the methodological procedures of these various forms of qualitative enquiry are detailed, in order to align this methodology with the paradigmatic foundations of this research, a brief critical reflection on the conceptual basis of this study's ethnographic approach will be offered. Since research ethics and consent are central concerns in modern ethnographic work (Scott Jones, 2010a; Jones, 2010), this section of the thesis also engages explicitly with some of the ethics protocols employed in this research.

4.2.1 Researchers cannot "see the world as participants do"

Guided by the positivist conceptual paradigm that sought to disinterestedly employ methods in pursuit of 'truth' (see section 3.5.1.1), Malinowski (1922: 25) described the ethnographer's goal as being to "grasp the native's point of view". Such a commitment enabled early researchers to exclude themselves from their work and to overlook how their own identity (often that of a white, middle class, Western male) might have influenced their engagements with the field setting and have shaped their research output. Through their ethnographic accounts such researchers typically espoused grand narratives, presented as timeless definitive accounts (Scott Jones, 2010b: 23).

A positivist epistemic basis has not been fully surrendered by all ethnographers. Some still seek to maintain their cognitive distance from the research subject and pursue the "really real" (Behar, 2003: 16). However as described in section 3.5.1.2, the theoretical, academic, cultural and social transformation of the 'postmodern turn' shifted social science theory and praxis towards a constructivist reflexivity, in which the assumption that researchers could operate from behind a "one way mirror" broke down (Guba & Lincoln, 1994; Healy & Perry, 2000). This paradigm shift introduced new foci to ethnography: Reflexivity, ethics, representation, subjectivity, inclusion and relativism (Davis, 1999; Scott Jones, 2010b). As reflexive ethnographers began to reveal how earlier ethnographic grand narratives had served to disempower, marginalise, exclude and oppress, objectivity in ethnographic work was re-cast as a dangerous illusion (Fine, 1994; Jones 2010).

First Nations Canadians have experienced long-standing post-colonial legacy of social disadvantage and political disempowerment: "Cultural ethnocide", in the words of Stavenhagen (2004: 23). Today however the Haida are a politically active and influential group who have fought with passion and determination to secure increasing control over their own future and cultural heritage (Gill, 2009, see chapter 5). In this context as much as in any, it is of fundamental importance that I acknowledge the role that geographical work has played (and could continue to play without due

care) in supporting, justifying and reinforcing colonizing processes, and the discipline's power to marginalise and oppress (Howitt, 2001; Posey, 2002; Rainbow, 1986; Sillitoe et al., 2002).

Self-conscious reflexivity that deconstructs and renders visible the very real processes and relationships that shape ethnographic work is therefore fundamental to ethical research (Davis, 1999). It is essential that researchers recognize the relational nature of knowledge production. Thus the write up of this ethnographic account needs to be understood as an inherently political act; a representation which may itself enter into a fight for legitimacy (Fine, 1994; Jones, 2010). As Christie (1992: 2) writes, the "text is not a neutral, passive presentation of an external truth". The final portion of this chapter, which is dedicated to critical reflection on situational research ethics and the role of the researcher (section 4.4), accordingly affords much attention to questions of power, representation and authorship. But first this chapter will detail the methodological protocols and sampling and analytic strategies pursued in this research. This begins with an overview of discourse analysis of English language newspaper discourse, which sets the scene for more immersive forms of qualitative enquiry.

4.2.2 Media Discourse Analysis

As discussed in section 2.3.1 media discourse and content analyses have formed a notable contribution to previous research on perceptions of geoengineering. To prepare myself for my upcoming fieldwork and to sensitize myself to existing accounts of the Haida Salmon Restoration Corporation project, this research consequently began in the UK with discourse analysis of media coverage of the HSRC project.

In keeping with the ambition to maintain an open and evolving study fieldsite that followed the 'conflict', 'plot, story or allegory' (c.f. Marcus, 1995: 109-110), this research engaged with diverse media outputs during the course of data collection. However in this first preparatory stage of research a more structured engagement with media discourse was pursued that explored accounts of the HSRC project in international newspaper discourse. In an age when more people are turning to alternative news sources, focusing solely on newspaper discourse would be limiting. However this was deemed a good starting point for the analysis since newspaper outputs can be systematically searched for and obtained with relative ease from the online database *Nexis*[30]. Newspapers also remain of high overall importance in media discourse and the *Nexis* database offers reasonable coverage of regional newspapers. This was important since it was anticipated that papers more local to Haida Gwaii would have afforded the HSRC project more attention and thus

[30] The online search engine *Nexis,* allowed newspaper articles to be searched and obtained with relative ease in the time available for the study. *Nexis* was the only newspaper database easily accessible through the University of East Anglia's *Athens* subscription (my host university at the time), and it has fairly good coverage for most newspapers in the recent past (see Porter, 2011).

regional newspapers were expected to make a particularly significant contribution to the corpus.

The first corpus of data collected for analysis was therefore articles from 'All English Language News' returned by a search of the *Nexis* database using the keywords "Haida" AND "Salmon" AND "Ocean fertilization" OR Ocean fertilisation"[31]. More articles were written and became available through this database during the course of my fieldwork, thus this search was repeated at the end of my fieldwork[32]. A total of 64 unique articles were obtained from this database making it practicable to sample the entire corpus of articles. Discourse was then explored in keeping with the 'informed grounded theory' approach to analysis described below (see section 4.2.4).

In addition to the opportunity to explore existing accounts of the HSRC project, analysis of media discourse offered the opportunity to gain insight into how the story of the HSRC project had travelled spatially and temporally. More quantitative forms of content analysis[33] also enabled me to identify key 'claims makers' (Hansen, 2000) and thus to get a sense of whose account of the HSRC project was being amplified and whose might be being silenced. Through this analysis it became apparent however that a limited set of voices were shaping this discourse and that media discourse therefore offered limited opportunity to explore the research questions. This finding stressed the importance of pursuing alternative forms of enquiry to enlarge the analysis.

4.2.3 Following the Conflict, Plot, Story or Allegory: Participant Observation, Interviews and a Focus Group

Ethnographic research has traditionally been conducted over years rather than months (Okely, 1992). However in what is often labelled a 'mini-ethnography' (Hamlin, 2013; Padilla et al., 2014), keen to facilitate its application in time and resource limited research settings, this convention is one of many practices that has been interrogated and reconfigured by modern ethnographers (Amit, 2000)[34]. To conduct my own 'mini-ethnography', I spent close to eight months in British

[31] These search terms were refined through trial and error. News articles that offered less explicit references to the project may have been missed by the search, but these terms were felt to return a satisfactory corpus of articles.

[32] The final search was conducted on August 25th 2014, so articles written about the HSRC after this time were less likely to have been identified and engaged with during the fieldwork.

[33] In contrast to frame analysis for which both interpretative and more positivist approaches are commonly employed, traditional approaches to content analysis typically aspire to capture 'unambiguous' quantitative data. As understood by Gaskell (1998: 8), traditional content analysis often "treats media texts as the 'objectified' traces of the complex communication process from senders to receivers". In this research interpretation of content analysis data was not considered to be the final objective reading of the material, as Berelson (1952) argued of classical content analysis. But rather the quantitative data collected served only as a further interpretative resource to enrich the qualitative analysis.

[34] Fetterman (1998: 35) suggests between six months and a year to be an acceptable timeframe in which to "internalize the basic beliefs, fears, hopes and expectations of the people under study".

Columbia between July 2013 and May 2014[35]. The majority of this time was spent on island, moving between the different settlements on Haida Gwaii. However since the HSRC is a Vancouver-based company, I also spent time in Vancouver.

To help ease the transition into the field setting, I registered as a visiting scholar at the University of British Columbia (UBC). Time spent at UBC at the start of my fieldwork gave me a base from which to make logistical arrangements for research in Haida Gwaii. It also allowed me to identify other researchers with experience of conducting fieldwork on the islands, who were able to point me towards useful contacts and help me develop a clearer initial understanding of the social and political context. Through this time at UBC I was also able to access new resources on First Nations (and especially Haida) history, traditional knowledge, political activism, reconciliation activities, art and culture. This early research contextualized my engagement and better equipped me to sensitively approach the Haida Gwaii fieldsite[36]. During this time I was also able to make contact, and conduct initial meetings, with Vancouver-based HSRC directors and employees.

4.2.3.1 Participant Observation

Watt & Scott Jones (2010: 109) describe the purpose of ethnographic participant observation as being to "observe people in their natural surroundings, their everyday behaviour, interactions, routines and rituals, along with the artefacts and symbols that bring meaning to their lives, while of course, conversing and listening to their narratives". In reality an ethnographer may assume different roles and levels of participation within a field setting. Gold (1958) offered a useful classification system for the roles an ethnographer may assume, which Bryman (2006) locates on a

[35] Fieldwork was conducted in 2 phases, to align broadly speaking with the two phases of data collection outlined in this chapter. The first period of fieldwork was conducted between July-Nov 2013, while the second period took place between Jan-May 2014.

[36] Approaching the field-site steadily and cautiously in this way proved valuable in ensuring the ethical integrity of the research. As Jerstad (2012: 2) writes of ethnographic research, "action has the potential to cause unintended harm. A stranger entering society cannot know all that is appropriate. Clumsiness in the learning phase prefaces full social personhood, when knowledge allows for calculated action and avoidance of harm – in subjective terms". This more measured approach to entering the field-site proved particularly important for sensitizing me to the additional challenges of conducting research among Indigenous peoples. Scholars from indigenous rights literatures have, as Hart (2010: 6) describes, resisted "academic discourse that strips Indigenous intellectual traditions of their spiritual and sacred elements". This reductionism is its own expression of ontological hegemony, through which dominant knowledges colonize alternative perspectives (see Rose, 1999; Howitt, 2001; Howitt & Suchet-Pearson, 2006; Suchet, 2002). Thus to engage more meaningfully and ethically with some of the attachments I encountered (in an interpretivist sense) during my research, I needed to learn new language and new ways of talking about the environment. For this a new kind of openness was needed which, reminiscent of feminist research protocols, made way for new forms of emotional and experiential knowing (Stanley & Wise, 1983). It is important to recognise my limitations in this regard: In the time allowed for fieldwork there was only so much of this literacy that I could expect to develop. However this early effort to contextualize my engagement reiterated the importance of the goals of reflexivity, situating my research in context, reflective non-judgement (c.f. Hart, 2010) and being open to being challenged, thus it made way for new forms of engagement and deeper forms of listening and connection.

continuum ranging from detachment (complete observer) to involvement (complete participant). These typologies are summarized in Figure 4.1 below.

Figure 4.1: Different roles, and degrees of participation, within a field setting an ethnographer may assume

Complete Observer	Observer as Participant	Participant as Observer	Complete Participant
Strives for complete detachment and objectivity.	Clear research boundaries are constructed with the intention of remaining a neutral researcher.	Researcher seeks to build a more involved relationship with the researched, whilst seeking to maintain as neutral as possible.	The researcher seeks to fully engage emotionally, mentally, socially and physically in the research setting.
Conducts covert research.	The status of the researcher is known to the researched.	The status of the researcher is known to the researched.	Research may be covert or the researcher may make their identity known.
← **Detachment**			**Involvement** →

Based on Gold, (1958) and Bryman (2006).

In this research I sought to adopt a role that would sit close to the involvement end of the continuum, that, reflecting Watt & Scott Jones's (2010) above description, sought to maximise my emotional, mental, social and physical engagement in the research setting. Complete membership in the research setting (c.f. Adler & Adler, 1994) was an unrealistic ambition, but I sought to engage with the group and participate within social life where possible, and thus pursued a more 'peripheral' membership role within the research setting (c.f. Adler & Adler, 1994). In this way my research followed modern research conventions that understand ethnography to be an inherently social experience. Deviating from Gold's (1958) typology however my status as a researcher was made clear to informants, so as to make possible informed consent[37].

When I arrived in Haida Gwaii I therefore sought to embrace opportunities for such forms of participant observation wherever possible. I spent time working from cafes and the Haida Heritage Centre at Kay Llnagaay. I went to the bars, restaurants, public gatherings and anywhere else where people congregated whenever possible. I contacted significant political, social and environmental institutions to introduce myself, make my research interests known and seek meetings. I attended Haida potlatch and celebratory events as well as outreach events run by various organisations and community groups on island.

In many ways this experience became truly participatory. As I read local newspapers and community publications I found myself becoming concerned by many of the same local issues as other island residents: The Enbridge pipeline proposal and BC Ferries cuts, to offer two of the

[37] Bryman (2006) notes that the overt/covert distinction is problematic, since not everyone that an ethnographer encounters and interacts with will be aware of the researcher's identity. Whilst I always strived to maintain transparency, this distinction therefore really came to fruition during the more structured forms of interview and focus group elicitation.

most obvious examples. I also experienced some of the same challenges of life on a remote Canadian archipelago that were reported to me by informants, such as the limited public service provision and a high cost of living.

During this time knowledge of the HSRC project was elicited more directly through informal daily interactions with residents. Explaining my research interest to those I encountered often sparked intrigue and prompted discussion. Further through these conversations I was often referred to related documents and audio-visual material (c.f. Hammersley & Atkinson, 2007). Early public outreach communication, and newsletters issued by the HSRC's Haida funding body, Old Massett Village Council (OMVC), as well as other related Haida government and village council documents, were attained through these means. So too were recordings and minutes of public meetings and interviews held by OMVC and the HSRC. Recordings of public lectures led by ETC group's Pat Mooney were also supplied by informants. Importantly these sources also provided a record of some of the public questions and debate that had followed such presentations. Since this material predated international awareness of the project, this material allowed me to develop more of a sense of how the story of the HSRC had travelled over time.

In this same vein, I was kindly afforded access to local newspaper archives at the *Haida Gwaii Observer* that enabled me to trace local reportage. Further through participant observation and informal interactions with informants, I was also sensitized to the key national and international media outputs that had entered and iterated with discussion and meaning-making about the project on island[38]. Thus following the 'conflict, plot, story or allegory' (see section 3.8.2.2) I was able to incorporate these into the corpus of fieldwork data for analysis.

I initially suspected that the HSRC would be difficult to penetrate as an ethnographic researcher[39] and thus I anticipated being dependent upon using only the discourse of HSRC actors in this secondary data for analysis. I therefore also dedicated significant time to exploring the extensive content available on the HSRC website, paying particular attention to the large collection of blogs written about the project's aims and motivations[40]. On this assumption I was however very happily

[38] The documentary "Ironman" by CBC's The Fifth Estate being one of the most visible examples (CBC, 2013).

[39] In the 9 months prior to my fieldwork, the Corporation had received extensive media interest. An earlier version of the HSRC website featured a designated application and screening process with a series of "ground rules" for anyone wishing to make contact with the Corporation. This process was described as a response to "recent strawman representations of us [that] make it crystal clear many in the media assume we are fair game for any purpose they desire". The explanation continued "Tote up the attack and gotcha journalism stories fomenting lies about our work and do some research on who are the culprits and shill journalists behind those lies… The score is about 150 feeding frenzy journalist hacks writing lies about us vs.1 middle of the road piece and 1 positive truthful piece" (HSRC, 2013a).

[40] On May 25th 2013, using the capture tool *Sitesucker* I made a copy of the content available on the HSRC website to use for analysis. This website was later renovated and much of this original content removed. Later in the study I also explored the personal webpage of the HSRC's former director and chief scientist Russ

proved wrong. Changes to senior management at the HSRC had created a new desire for openness and several members of the HSRC were willing and indeed enthusiastic to engage with me. Such was this willingness to engage that all of those who actively held the position of HSRC Director during the time at which my fieldwork commenced generously participated in the interview stage of my research process. This early engagement with public discourse of the HSRC nevertheless contextualized the interviews and offered another means through which to explore how the 'conflict, plot, story or allegory' had changed over time.

Fetterman (1998: 35) describes that in the early stages of participant observation, research can appear "uncontrolled" and "haphazard". At times my copious field-notes – often initially scribbled in haste during fleeting moments of privacy – and detailed field-diary ideas did indeed seem chaotic. However this participation in the field setting proved fundamental to accessing a deep engagement with meaning-making about the HSRC project in Haida Gwaii and to relating interpretations to the wider socio-cultural setting. This open and informal engagement with the field setting was also central to the process of interview protocol development (see section 4.2.3.2.1).

The importance of this period for gaining acceptance and trust in the research setting and for developing personal relationships that would facilitate the elicitation of findings and insight should also not be underestimated (c.f. Amit, 2000; Hammersley & Atkinson, 2007). As Bryman (2006) describes, gaining access to a social setting is one of the most fundamental but difficult steps of ethnography. The islands are home to fewer than 4,500 inhabitants who primarily live within eight main settlements. As a result the Island's communities are commonly described as being 'tightly-knit'. Through daily social and informal engagements I aimed to become 'known' and then later trusted by as many residents and social groups as possible. My efforts in this regard were returned many times over and during my fieldwork I received and accepted a vast range of invitations for dinner at people's homes, for fishing trips, for days at the beach, for local community events. I went hiking to explore cultural features of the landscape with islanders. I shared in local gossip. At times I even became local gossip.

Through these interactions over time 'contacts' became friends and this familiarity and trust allowed me to identify gatekeepers and receive key introductions. I also received opportunities to attend and participate in discussions on community development and environmental management

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George. Provided that online data has been "deliberately and voluntarily made available in the public Internet domain" (Hewson et al., 2003: 53), online content is understood as being comprised of 'texts' that have been authored and intentionally and voluntarily made available (Bassett & O'Riordan, 2002: 235). As Witschge (2007: 36) writes of online texts: "They are *published* as, for instance, a letter to the editor is published". These assumptions thus characterize internet content as a product akin to other media outputs, (e.g. from print media and television and radio broadcasts) which, being in the public domain leaves dialogue available for reproduction and analysis.

strategies that exposed me, for example, to existing governance structures, knowledge of environmental and co-management agreements and social challenges and policies. At times I even received key logistical support – discounted places to stay, the offer of a ride, freshly caught salmon for my dinner! Collectively these opportunities offered a much richer and deeper experience of island life, but also ensured my emotional and physical wellbeing, as the human relationships that ensued from these interactions became deeply rewarding and personally meaningful.

4.2.3.2 Non Observational Elicitation Methods: In-depth Semi-Structured Interviews and a Focus Group

Alongside this more open and flexible approach to exploring meaning-making around the HSRC project, where data had been gathered from whatever sources were available to me, I sought to pursue more active, non-observational means of engaging with informants. The following section of this chapter will therefore detail the methodological processes through which I conducted 44 semi-structured, in-depth interviews of varying formality as well as a focus group with a further 13 participants[41]. This section of the chapter will also detail the way in which participants for this phase of the research were sampled through a combination of convenience, snowball and theoretical sampling methods. It will additionally address the process of interview schedule development, as well as some of the protocols developed to record and organise data.

4.2.3.2.1 Development of Semi-Structured Interview Guides

Interviews are commonly used in ethnographic research. However approaches to ethnographic interviewing vary significantly, most obviously in the degree of structure that researchers seek to impose on their interactions (see Bryman, 2006). Denzin (1984) argues that when studying lived phenomena it is fundamental that those phenomena are studied from the point of view of the people experiencing them. Of course constructivist philosophy and an understanding of the relational nature of knowledge production limits the extent to which this goal is understood as realizable. However, in contrast to a pre-determined and fixed interview protocol, which presumes that researchers have the greatest knowledge of what questions need to be asked and in what form (Oliver, 1992; Shanklin, 1979), a less structured approach can nevertheless help ensure that as far as possible participants are able to define the issues, reflect their own priorities and shape the interview agenda themselves.

In this research a more open approach to enquiry was therefore pursued in the belief that it would allow participants to construct and articulate a more meaningful characterization of their worldview

[41] A further four participants were interviewed after completing the Q-sort exercise, bringing the total number of interviewed participants to 48. An anonymized list of participants is provided in appendices 4.1 and 4.2.

(e.g. see Glen in Burgess et al., 1988)[42]. To provoke discussion and to ensure that the interviews would help explicate the research questions, a semi-structured, rather than an unstructured interview approach was nevertheless deemed preferable[43]. Thus it was necessary to formulate some general interview themes and questions that would be used to help guide, but not lead, discussion and that would help me answer my research questions. Section 2.8.1 detailed the way in which previous research on perceptions of geoengineering has at times been seen to have introduced unintentional framing conditions, that may have lead research participants to reproduce dominant framings and problem definitions (e.g. Corner et al., 2011). Being mindful to minimise such framing effects while constructing the interview schedule themes and questions was therefore fundamental to this research. I will now offer a brief overview of how the interview schedule attempted to mitigate this risk.

Recruiting participants topic-blind has been advanced in deliberative work on geoengineering as a means of avoiding unintended framing effects (Bellamy et al., 2014; Corner et al., 2013). The theory follows that introducing higher-level issues first can help facilitate "the expression of [participants] beliefs unconstrained by the researchers expectations" (Bostrom et al., 1993: 960). However given the sensitive and controversial nature of the project on island (see chapter 5), transparency about the research subject was deemed to be important to the ethical integrity of the research[44]. My interest in exploring respondents' perceptions of the 'environmental management strategies of the Haida Salmon Restoration Corporation' was therefore clearly specified at the start of the interview process. And at this time I detailed my research interest in using HSRC project as an entry point into thinking about wider debates about global environmental management. At times, when it was felt necessary and appropriate, this was further specified to be an interest in the carbon dioxide removal ambitions of the HSRC and an interest in wider debates about geoengineering.

As the interviews unfolded, care was taken to ensure that all participants took on board the remit of the research and its aims. In explaining these I endeavoured to use language as familiar to participants as possible[45]. However as a fairly complex academic pursuit, in some instances during the interviews participants sought further clarification about the scientific basis of anthropogenic climate change and geoengineering proposals. This situation was anticipated and thus brief tutorials

[42] Maintaining a more open approach was also consistent with the grounded analytical strategy which seeks to avoid the early application of theory and concepts. This thesis has additionally detailed some of the ways in which these more 'flexible' research strategies may be more compatible with calls for more emancipatory approaches to research, which help the researcher to build trust, respect, participation and reciprocity between researcher and researched (Chambliss & Schutt, 2010; Lather 1987; Strauss & Corbin, 1990).
[43] As explained by Bernard (2013: 182), semi-structured interviews have "much of the freewheeling quality of unstructured interviewing and requires all the same skills".
[44] Without this transparency obtaining informed consent was untenable.
[45] This process was aided by participants' general existing familiarity with the concept of carbon sequestration, since following the HSRC's project very few people I encountered had no understanding of at least the principal of what the HSRC project had promised to deliver.

were prepared for in advance of conducting the interviews. However where possible, these tutorials were delayed until a later point in the discussion so that participants' own ideas could emerge first[46]. When more general avenues of enquiry had been exhausted, it seemed appropriate to offer more guidance when requested.

In these tutorials great care was taken to present this information in as neutral a format as possible[47]. Echoing previous deliberative techniques (e.g. Bellamy et al., 2014; Macnaghten & Szerszynski, 2013) I sought to ensure that geoengineering, and ocean fertilization specifically, were understood as among many proposals for how humanity may respond to anthropogenic climate change. I also sought to avoid reproducing narrow problem framings (e.g. climate emergency frames). Given the organic nature of discussions – and my professional exposure to these frames - it was nevertheless possible that at times I inadvertently defined the topic in line with existing dominant framings. Yet by recording and transcribing interviews I was afforded the opportunity for detailed reflection on where these frames could have been accidentally introduced. In the rare instances that I later became concerned that I may have overtly influenced particular assertions that

[46] Delaying these discussions was especially important to ensure that I was able to get a sense of how participants observed and made sense of the HSRC project and changes in their own environment within their own frame of reference. As de Wit (2011), explained when engaging grassroot farmers who had never heard of climate change, she avoided engaging them directly in discussions about whether they thought the climate change was changing, since by doing so she would have risked creating a discursive frame through which they would start to make sense of their experience. Had she pursued such lines of questioning she explained she risked "talking climate change into existence" (de Wit, 2011: 42). Participants were generally familiar with the concept of anthropogenic climate change (see section 5.6.4) (indeed even those who adopted skeptical positions generally expressed a fairly comprehensive sentiment about its basic principles) however this could not have been foreseen at the start of the research process.

[47] Brief tutorials have been used in previous participation literatures on climate change (Kempton et al., 1991) and on geoengineering (Bellamy et al., 2014). In conducting his deliberative participatory approach to geoengineering appraisal with members of the Norfolk (UK) public, Rob Bellamy devoted much time to considering how to frame climate change and geoengineering as openly as possible. As a facilitator of one of his deliberative group discussions, I had received the opportunity to become familiar with his approach, which most notably involved presenting geoengineering as one of the many proposed responses to climate change alongside mitigation and adaptation options. The depth of his presentation was undoubtedly much deeper than I could create in an ethnographic field setting. He elicited geoengineering specialists to engage with, and be interrogated by, participants to inform their forthcoming appraisals, while my capacity to respond to such questions was more limited. I nevertheless took inspiration from Bellamy's protocol where possible. Alongside mitigation and adaptations options, Bellamy presented a small number of example geoengineering proposals and developed summary sheets for each to serve as stimuli for discussion. These were framed as neutrally as possible and offered artist impressions of different geoengineering proposals. With his permission I reused a number of these summary sheets at appropriate moments in my research. These summary sheets addressed proposals for ocean fertilization, sulphate aerosols, mirrors in space, cloud brightening, air capture (see appendix 4.3). Echoing Bellamy's design, I took care to emphasize that these were just a selection of many proposals and that in most cases the technologies did not yet exist; they largely represented scientists' speculative imaginings of technologies that may be developed in the future. I also made it clear when artists' impressions had been used. These emphases were significant since I sought to emphasize that the research was largely taking place 'upstream' and that the debate had not yet been closed down. To avoid 'science' acting as a legitimating label for the technologies, the contested nature of the proposals was also emphasized, and my interest in participants' *own* position was stressed. At times during these discussions I did echo the Royal Society's differentiation between CDR and SRM technologies, which is arguably a problematic distinction, but this generally seemed to help people better engage with the debate.

participants made, these sections of discussion could then be omitted from the corpus of data for analysis.

In keeping with the research questions, at times during the interviews the research was intentionally and overtly framed as being interested in exploring how meaning-making about the HSRC project interacted with beliefs about the relationship between nature and humans. I believe such a strategy is defensible since earlier public consultation research had already suggested that such implicit philosophical assumptions about the nature of nature, technology and human agency interacted with human meaning-making about geoengineering (see section 2.8): The research questions thus sought explicitly to explore *how* these assumptions were constructed and interpreted in the case study context. Moreover, making participants aware of my research goals in some ways maximised the opportunity for participants to lead the discussion themselves. By taking time to discuss the objectives of the research I was more able to encourage participants to see questions that I asked as entry points into our discussion, but not as definitive of the format of the interview. Particularly I was able to encourage participants to intervene in my lines of questioning if they felt alternative avenues could prove more fruitful[48]. Participants regularly embraced this opportunity, helping ensure discussion was more organic and hopefully more reflective of their lived experience.

On learning of my research topic, in some interviews participants jumped straight in to discussion of the HSRC project. But at other times interviewees engaged in wider debates about their relationship to the environment more generally and even to weather and climate. These avenues proved fruitful since getting people to articulate something resembling a 'worldview' is not a straightforward task. However echoing the five dimensions of the Hedlund-de Witt (e.g. 2012) Integrative Worldview Framework (see Figure 3.2), as can be seen in Vannini et al (2012), people develop and conduct complex relationships and interactions with the weather and with their environment that speak to different perspectives on reality (*ontology*), reveal different assumptions about the nature of knowing that reality (*epistemology*), and reveal different ethical or aesthetic values (*axiology*). Interactions with weather also speak to notions of identity, positioning humans in the universe (*anthropology*) and at times offering diverse problem definitions and policy prescriptions (*societal vision*).

Echoing a strategy adopted by Macnaghten & Szerszynski (2013), pursuing these open-ended discussions about participants' relationships with the local environment or about their experience of weather and climate therefore often provided a context for discussions about the

[48] "Tell me if I am asking the wrong questions, or if you feel I am missing the point with my questions", I would stress. "I am here to learn from you".

'geoengineering' ambitions of the HSRC[49]. Such avenues of discussion were therefore encouraged, and at times actively pursued through the research schedule.

In addition to these general discussions about the environment and weather and climate, the interview protocol posed questions about the HSRC project (surrounding the perceived goals of the project and its likely outcomes, for example). At times discussions also engaged in wider conversations about anthropogenic climate change (especially causes and responses) and about other geoengineering proposals. Seeking to situate the research in context, discussion often explored the salience of the discussion topics for Haida Gwaii specifically and since the branding of the HSRC project had been intertwined with a Haida cultural identity, this too was often developed as a line of conversation.

As will be discussed below, Hedlund-de Witt's (2013a, 2013b, 2013c, 2012, Hedlund-de Witt & Hedlund-de Witt, 2015, *in press*) Integrative Worldviews Framework was used as a lens to help structure analysis of the data collected in this phase of the research. Since this analytical process was evolving and iterative, early stages of participant observation and media and document analysis informed the development of these interview schedules. In this way Hedlund-de Witt's Integrative Worldviews Framework also played a formative role in the interview protocol development. This influence can be traced through the interview questions offered in an example interview guide in appendix 4.4, where on deeper inspection one can identify ways in which the questions posed resonate with the exemplary questions offered in the Hedlund-de Witt IWF framework[50].

An example interview guide is offered in appendix 4.4 as a means of increasing transparency of the methodological approach, but this must be understood as a rudimentary *guide* not a prescriptive schedule. In reality the interview protocol evolved iteratively between interviews, following feedback received from participants and in light of the way in which participants responded and brought their own framings to the interviews. Interviews also departed regularly from the schedule in response to points made by the participant that seemed worthy of following up. Which questions were asked and in what order also varied and different interview themes were often combined in a

[49] Vannini et al. (2012: 363) also hint at the potential of such a strategy when they write, "the ways people experience and talk about weather, the ways they develop emotional attachments and inhibitions to it, and the ways they sense and comprehend meteorological processes and draw significance from them are not only interesting but also particularly valuable as keys to deciphering larger scale social processes".

[50] To offer just a couple of examples of how this dynamic played out, a question such as "is there anything about the HSRC project that you would describe as touching an issue 'close to your heart?'" often opened the door for participants to reflect in terms that spoke to the IWF exemplary axiology questions "*What is a good life? What kind of life has quality and gives fulfillment? What are our most cherished ethical and aesthetic values? What is life all about?"*. While a question such as "people have often talked to me about the HSRC in terms of the idea of environmental 'stewardship'. What does stewardship mean to you? Do you find this term fitting? In what ways/why not?" often allowed participants to articulate diverse ideas that resonated particularly with such IWF exemplary anthropology questions as "*Who or what is the human being? What is the nature of the human being? What is his role and purpose in existence?"*. *(See Figure 3.2).*

more fluid conversation. Because the questions were not fixed, themes could be adapted to accommodate diverse entry points into thinking about the research subject, with participants who experienced diverse relationships with the topic, as well as different experiences, expertise and levels of engagement[51].

The interview schedule was piloted with four volunteers[52], which helped establish the adequacy of such an open approach for exploring the research questions. Piloting also helped me to refine my approach to questioning. I learnt for example that a well-placed pause often allowed respondents time to respond with deeper reflections. I was also able to identify, and take steps to eliminate, approaches to questioning that respondents were more likely to find confusing, confronting or otherwise uncomfortable. Seeking a high level of detail and elaboration from participants, during the piloting phase of the research I also became aware of the value of asking participants to approach the interview as a "storytelling" task[53]. As well as trying to avoid a scenario where the privilege of scientific rationality colonized the discursive space, I sought to emphasize that the project was interested in participants' personal '*values'* and '*worldviews'* (rather than their understanding of science per se). I additionally realized it was fruitful to ask participants to contrast their own understanding of a question with how they perceived others might answer that question. This was not because I wished to explore these imagined positions of others, but rather such a strategy helped respondents articulate what made their position unique.

I sought general guidance on interview facilitation from a range of literatures, which then informed my approach (e.g. Johnson & Weller, 2001). In keeping with my interest in open-ended questions, which do not imply a particular style of response is required, I tried to ask questions in as neutral a format as possible and to avoid leading statements. I tried to avoid closed questions in disguise e.g. 'how satisfied…', 'to what extent…' (c.f. Kruger & Casey, 2000). Use of the word 'why' was avoided where possible for its potential to make respondents feel confronted[54]. Examples were limited in questions to avoid implying to participants that a particular type of response was required. A degree of ambiguity in questions was permissible, helping ensure that participants were able to react to questions on their own terms. I also took time at the start of each interview to

[51] HSRC affiliates tended to talk first about the project. I would then often ask them to try to trace these thoughts into wider discussions about the weather and then other geoengineering proposals. But with people who did not have such detailed knowledge of the project it was generally most fruitful to explore the higher level issues first. A sample extract from interview transcription is offered in appendix 4.5.

[52] These volunteers were friends (n=2), family (n=1) and colleagues (n=1)

[53] "How you answer my questions is completely up to you. Having said this, throughout the interview I would be particularly keen to hear about any stories, myths, memories or experiences that our discussions may remind you of*"*, I would state at the start of the interview.

[54] As Kruger & Casey, (2000: 59) explain, "when asked 'why' respondents feel like they should have a rational answer … the participant 'intellectualises' the answer and speaks from the brain and not from deeper forces that motivate behaviour".

emphasize that the interview was in no way a test, and that there were no right or wrong ways to answer any questions asked.

4.2.3.2.2 Interview Sampling Strategies

This research employed non-probability sampling techniques. *Convenience sampling* took place through interactions with people I encountered in a variety of social settings, who were willing and interested to talk about my research. *Snowball sampling* was pursued when informants suggested other members of the population who they believed would serve as useful informants. *Purposive sampling* involved pursuing interactions with members of seemingly pertinent demographic, professional, social and political groups, as well as seeking to engage key claims makers and other dominant actors identified through media and document analysis (see Robson, 2011: 274-276).

These sampling strategies were appropriate since as specified in section 3.8.2 the field site itself was defined during the course of the research. Developing a probability sample from a pre-defined population was therefore untenable. Instead, in keeping with the 'follow the conflict, plot, story or allegory' tracking strategy (c.f. Marcus, 1995), this approach to sampling was flexible and responsive to my emerging engagement with the field setting. As familiarity with the field setting evolved, convenience sampling was largely dropped in favour of snowball and purposive approaches.

The final interview sample consisted of respondents who had, for example, participated in financing the HSRC project (directly and indirectly), respondents who had voted for and against the project, respondents from within the HSRC who had physically executed the project and who had managed or overseen the project. The sample also included respondents who had protested or spoken out against the project. A number of other participants felt their only association with the project had been that they had observed, or participated in, local discussions about the project or that they had watched the story of the HSRC project unfold.

My sampling rationale was to try and maximise diversity among the respondents. When snowball sampling I accordingly often asked informants to recommend participants who they anticipated to have different views to their own. Furthermore, whilst I did not expect the research findings to in any way conform to these variables, I sought to ensure that participants occupied a wide range of socio-demographic backgrounds. The final sample consisted of male and female[55] respondents ranging in age from their early 20s to their late 80s. I also recruited participants of diverse educational backgrounds: Some participants in the sample were illiterate and participants had

[55] Notably the final sample consisted of twice as many male respondents and female. This is partly due to the predominantly male membership of the HSRC and is a product of the 'follow the conflict, plot or allegory' tracking strategy. However in hindsight this male dominance is a weakness of the final composition of the study sample.

varying degrees of educational experiences, which ranged from primary school to doctoral level qualifications[56]. The sample was comprised of both Haida and non-Haida participants who were recruited from each of the eight notable settlements on island[57]. Based on Macnaghten & Szerszynski's (2013: 468) assumption that groups with different occupations, experiences and interests may exhibit different 'lifeworld orientations' – and thus that they may bring different sets of interpretative resources to engaging with the HSRC – I also sought to sample participants who worked within as many different social, political and environmental organisations on island as possible and who adopted as many different personal identity labels as possible[58]. Careful anonymity protocols were developed to maintain the confidentiality of all participants[59].

The sampling strategies adopted in this research risked exposing me to only very visible or even 'elite' actors in the HSRC allegory. Thus I also invested significant time in seeking out and encouraging participation from seemingly quieter and less visible voices, who may not have initially appreciated the value of their own contributions to the research. As a final strategy intended to open up the research to a wider range of perspectives, I put an advert in the widely read Haida Gwaii newspaper *The Haida Gwaii Observer,* inviting readers to get in touch if they would like to "share their feelings on ocean fertilization" (see appendix 4.7)[60].

Remittances are often paid in social research to increase response rates. Given the varying formality with which respondents engaged in the research remittances were felt to be logistically difficult. Further in light of the sensitive nature of the issue on island I also sought to ensure that no one felt

[56] In this way some interviews took on a format more reminiscent of elite interviews, which as Mahony (2013 : 94-98) eloquently describes, can present their own set of challenges and opportunities.
[57] See appendices 4.1 and 4.2.
[58] A list of some of the many labels through which interview participants described themselves is offered in appendix 4.6. This list is offered as an indication of the diversity of the study participants. It is very important to note however that participants did not seek to speak for any of the institutions with which they may be affiliated. Indeed many participants took great care to emphasize that the views they expressed were their own. It must be understood therefore that this list is not intended to imply that these institutions have been 'sampled' or indeed that this research has any kind of affiliation with the institutions listed.
[59] Preserving anonymity of the researched is a standard social science research ethics protocol, and every effort was made to maintain confidentiality during this research. As is outlined in more detail in appendix 4.6, in a remote and "close-knit" community, at times preserving anonymity required some creativity to avoid traceability. In keeping with established protocols, all participants were allocated a pseudonym using a random name generator (http://random-name-generator.info). However in this research the particularities of participant's affiliations, backgrounds and personalities were also disclosed with the minimal detail necessary for the reader to gain a meaningful understanding of the analysis, and only if such disclosures did not risk exposing individual identities. At times quotes interspersed in the analysis have been edited to remove personal or specific details that could have permitted identification.
[60] No one responded to this advert. It is possible that through this medium I did not manage to successfully stress that expertise was not required to participate in the study. Alternatively it is also possible that because of the sensitive nature of the research subject (see chapter 5) potential respondents felt unwilling to pursue such discussions with someone they had neither encountered, nor who had been introduced to them through a personal recommendation (perhaps highlighting the significance of gatekeepers in securing access to participants).

coerced or impelled to participate where they were not comfortable to do so. Participation was therefore on an entirely voluntary and unpaid basis[61].

4.2.3.2.3 Conducting Semi-Structured Interviews and a Focus Group

Following the outlined sampling strategies, a total of 44 semi-structured interviews of varying formality were conducted. Formal interviews lasted between one and six hours[62], and were often split into several sessions. They were mostly conducted in a one-to-one format[63] and where possible interviews were conducted in places familiar to participants, most commonly in their homes, their places of work or in other familiar public spaces. In a manner reminiscent of "walkabout methods" (e.g. see Strang, 2010), at times I accompanied participants as they went about their daily business. Conducting an interview whilst bouncing around logging roads in the back of a pick-up truck presents its own set of challenges. However in some ways such interactions proved particularly fruitful. This movement both helped reduce the formality of the interaction – as Strang (2010: 151) writes, "in motion people are more relaxed and forthcoming" - but the changing physical landscapes also appeared to hold a mnemonic value that these interviews profited from.

Most interviews were audio-recorded and transcribed verbatim with participants' informed written consent. Sharpe (1998) notes that the presence of recording equipment may limit a respondent's spontaneity and candour. However interviewees generally appeared to interact remarkably openly[64]. Indeed many offered very sensitive and personal disclosures, which I was honoured to be entrusted with.

When I first arrived in Haida Gwaii I was invited to join a group of mostly retired Sandspit residents that regularly meet for coffee and to use this group as a forum through which to conduct an opportunistic focus group. Focus groups (Kruger & Casey, 2000) or 'small groups' (Burgess et al., 1988) initially seemed very desirable research methods[65]. Thus this generous opportunity was

[61] After winning an island fundraising raffle I did however make a $500 donation to a local junior basketball team, as a small, tokenistic gesture of all that the community had done to help me with my research. A number of respondents' children and grandchildren, nephews and nieces, friends and friends' children were members of this team and the team was fundraising to help finance participation in an off-island tournament.

[62] Interviews lasted a little over 2 hours on average.

[63] In a few instances, when participants had been encountered together and when they had an existing close relationship, interviews were conducted in pairs. It is conceivable that one or the other participant could have dominated the discussion and thus reduced the opportunity for the other participant to contribute as freely. Another's presence may have also reduced a participant's willingness to engage in frank and open exchange. However careful facilitation helped minimise these risks and generally the 'bouncing around' of ideas among close friends appeared to encourage the sharing of ideas, rather than inhibit them.

[64] Participants were asked to give formal written consent before recordings were made. However it is possible that by using computer-based recording software on a laptop that was already present within the room, rather than positioning a visible recording device between myself and the participant, helped the participant to relax into the interview rather than focusing on the recording.

[65] The insights that can be gained from discussion within a focus group can be richer than those offered by interviewing alone since participants are engaged in a dialogue, sharing ideas and responding to the views of

pursued and, with a further 13 participants (10 male and 3 female[66]), I piloted a focus group loosely based around an early version of the semi-structured interview protocol. Participants knew each other well, which in this context ensured that the group interacted freely (c.f. Stewart et al., 2007), although facilitation to keep the group 'on topic' proved tricky.

This particular focus group proved a fruitful entry point into exploring my research question and the data was introduced into the iterative analytical process (see below). For ethical reasons the decision was nevertheless made to not pursue this method further. I felt confident that during the focus group this group of participants felt comfortable to speak freely and that few consequences were likely to result from members expressing their opinions to the group. However as I became familiar with the depth of tension that the project had introduced to some groups in Haida Gwaii (see chapter 5), I feared that bringing together actors who had been more closely involved in this conflict would risk exacerbating these tensions.

4.2.3.2.4 Storing and Retrieving Data

A large volume of data was collected through the methods outlined above thus careful data storage procedures were developed. Field notes and other observational data records were written up at the end of each day and stored using *Scrivener* : Word-processing software that offers advanced data management features which facilitate the organisation and easy retrieval of text, image, web-page, PDF, and audio-visual files. Interviews were transcribed verbatim at the earliest moment after an interview had been conducted[67] and these transcripts were similarly stored in *Scrivener*.

4.2.4 Analyzing Data Collected through Ethnographic Qualitative Enquiry

4.2.4.1 Informed Grounded Theory

Ethnographers rarely see analysis as a distinct phase of the research (Hammersley & Atkinson, 2007) and as has been detailed in this chapter, analysis in this research commenced in advance of the fieldwork and evolved iteratively, shaping further data collection activities. This moving backwards and forwards between data collection and analysis is typical of grounded theory (GT) approaches to generating theory or concepts from qualitative data (Hammersley & Atkinson, 2007). The aims of this research fit comfortably within the remit of grounded analytic approaches. "Constructivist grounded theorists seek meaning in the data that goes beyond the surface, searching and questioning for tacit meanings about values, beliefs and ideologies", Mills et al. (2006: 12) write.

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others. Such a 'bouncing around' of ideas, as well as the social processes of agreement and disagreement between participants, can move discussion beyond the responses that could be gained in isolated interviews (Burgess et al., 1988; Krueger & Casey, 2000). And as argued by Burgess et al., (1988: 314), if set up mindfully by the researcher, the small group, closely related to the focus group, can be "empowered to raise its own 'agenda', and to develop its own associations and narratives. And to do so without the interference of the researcher".

[66] Since this was an opportunity sample I had no control over the demographic make up of the focus group.

[67] When recordings were not possible, notes from interviews were always written up within 24 hours.

As a research method that seeks to be open and sensitive to the empirical data, without forcing it to 'fit' pre-conceived theory or concepts, recent iterations of grounded theory were therefore selected as the analytical strategy of this research.

Essential grounded theory analytical techniques include iterative coding phases and concurrent constant comparison analysis; through which the data is repeatedly 'pawed' (Taylor & Gibbs, 2010), compared, contrasted, interpreted and reinterpreted to develop and refine themes from the data that shed light on the research questions (Birk & Mills, 2011; Charmaz, 2006). Early grounded theorists advocated delaying literature review so as to avoid 'contaminating' the analysis and the risk of a researcher uncritically forcing data into pre-existing theories and categories (Thornberg, 2012). However as discussed in section 3.5.1.3, among modern reflexive researchers such notions of naive empiricism and pure induction are a fallacy, and a dangerous one at that (Bryant, 2009; Charmaz, 2006; Gamson & Modignliani, 1989; Thornberg, 2012).

Building on more recent forms of constructivist grounded theory (Bryant, 2009, Bryant & Charmaz, 2007; Charmaz, 2006), this research pursued a more overtly 'informed' approach to grounded analysis (c.f. Thornberg, 2012: 249). 'Informed grounded theory' still resists commencing research from a theoretical hypothesis and emphasizes the need to remain focused on the data not on literature (Thornberg, 2012). However providing that they are not used in ways that stifle rigorous, critical, creative and sensitive interrogation of the data, researchers pursuing more 'informed' approaches to grounded theory recognise the potential value of pre-existing theories and concepts for their research. Literature may be seen as a sensitizing resource. And, deployed creatively and reflexively, a researcher's experience and skill may be recast as an aid rather than a hindrance to research[68]. As Dey (1993: 63, in Thornberg, 2012) poignantly summarizes, there is a "difference between an open mind and an empty head".

4.2.4.2 Using Hedlund-de Witt's Integrative Worldviews Framework as an Orienting Heuristic to Paw the Data

Informed grounded theory is compatible with deploying pre-existing theories and concepts as heuristic tools or analytical lenses to help 'paw' the data, stimulate interrogation and to focus attention on particular aspects of the data collected (Thornberg, 2012). It is therefore compatible with my intended use of Annick Hedlund-de Witt's Integrative Worldviews Framework which, as discussed in section 3.4.3, differentiates 'worldviews' into five distinct but interrelated and encompassing aspects: Ontology, epistemology, axiology, anthropology and societal vision. In this research I am not trying to prove or disprove Hedlund-de Witt's framework (Figure 3.2), nor her ideal-typical worldview heuristics (see appendix 3.2). Instead my interest in these five foci rests in

[68] As Thornberg (2012: 244) so aptly notes, taken literally the classic grounded theory dictum of delaying literature review until after data collection and analysis would make "it impossible for researchers to conduct studies in their own areas of expertise".

their potential to serve as orienting heuristics to help structure a more comprehensive investigation of the data. I therefore used these foci and their exemplar questions (see Figure 3.2) informally within the evolving coding frame, to stimulate line-by-line interrogation of the data as part of a holistic exploration of the research questions.

Verbatim transcription of interview and focus group recordings actually proved to be a valuable phase of this analytical process. Whilst transcription was a very time consuming process[69] the careful noting of each word proved to be a powerful means of immersing oneself within the data, allowing meanings to be slowly absorbed and interpreted. A range of sophisticated specialist qualitative data analysis software exists to help with this analytical process. However *Scrivener* was used for the majority of the pawing and coding of the data[70]. At times a pack of highlighters and a pair of scissors also allowed me to physically play with the data and visualise connections between codes and emerging themes (see appendix 4.8).

Broadly speaking this analytic approach was continued until adding new data did not appear to provide me with further opportunities to elaborate or refine the themes and categories that I had formulated. Deviating slightly from the grounded theory concept of theoretical saturation (c.f. Glaser & Strauss, 1967) however, I recognized that the research topic was too vast to assume that I would uncover all of the salient interactions within the discourse. I thus understood my research task to be only to access 'situated glimpses' (Rose & Gilbert, 2005; Howitt, 2001; Howitt & Suchet-Pearson, 2006) into meaning-making surrounding my research questions. By employing Hedlund-de Witt's five 'worldview' foci I was afforded a tool through which to more transparently systematise this interrogation of the data. Yet the more informal, interpretative application of the framework left me free to pursue particularly interesting research trajectories emphasized by participants.

4.2.4.3 Analysis of Issue Frames

After extensive iterative grounded coding and analysis of the data, I made the *a posteriori* decision to structure and write up this discourse analysis as a frame analysis. Frame analysis is a particular form of discourse analysis that allows researchers to focus on how an issue is defined and problematised

[69] My experience of transcription broadly matched estimates in the literature, which suggest it takes 6 to 8 hours for every one hour of conversation recorded in an interview (Wutich & Gravlee, 2010).

[70] *Scrivener* was originally intended as an interim data storage system and I intended to use specialist qualitative data analysis software to conduct the analysis. At the time of my fieldwork *Nvivo* was not yet available for Mac operating systems so I obtained a subscription to rival software, *Dedoose*. *Dedoose* however requires a reliable internet connection. I had naively assumed such a connection would be universally available in North America, however internet access in Haida Gwaii was often not fast enough to facilitate the use of this software. Whilst a frustrating oversight at the time, its limited role in my analytical process proved a blessing in disguise since in the Spring of 2014 *Dedoose* suffered a major systems failure. Its storage system was corrupted and large volumes of data and hours worth of coding were lost from my project, as well as those of countless others (Straumsheim, 2014).

(Hope, 2010). Frames are a way of representing constellations of meaning and contestation, which amplify different priorities, beliefs and values. They tell stories about what should be thought of as the essence of an issue (c.f. Cappella & Jamieson, 1997; Snow & Benford, 2005). As Gamson & Modigliani (1989: 3) describe, as an interpretative package, frames form "a central organizing idea… for making sense of relevant events [and for] suggesting what is at issue" (see also section 2.3.1). The data appeared to lend itself particularly well to the construction of frames and thus frame analysis was felt to offer a fruitful way of developing schema to structure the presentation of the data from this stage of the analysis. Such an analytical approach was also felt likely to help facilitate and encourage consideration of the similarities and differences between discourse within this case study with that described in earlier geoengineering social science research.

De Vreese (2002) offers a useful distinction between the types of frames that that have been sought in past framing research. Certain frames, labelled 'issue-specific' frames, de Vresse claims are pertinent only to specific topics or events, while other frames, labelled 'generic frames', are explicitly designed to transcend thematic limitations and to be identifiable in relation to different topics, perhaps over time or in different cultural contexts. Generic framings have arisen from desires to consolidate the disparate field of framing research and to form standardized frames to allow greater comparability[71]. Issue-specific frames meanwhile are generally developed under the understanding that they will have thematic limitations, likely being relevant only to the particular issue under consideration. But they offer researchers greater opportunity to characterize issue-specific discourse (e.g. see Jasperson et al. 1998; Roessler, 2001; Shah et al., 2002).

To best characterize the discourse explored in the HSRC case study and to prevent me from being encouraged to force discourse into widely recognisable categories, it was fundamental that the frames developed be allowed to freely emerge from those elements of the discourse that I interpreted as most important to the research questions. It is for this reason that the study overtly sought to construct issue-specific frames. From the frame analysis, frame summaries were generated to describe the issue-frames identified in the course of the analysis and to highlight some of the many themes and meanings that had emerged from this initial interrogation of the discourse[72].

4.3 Phase Two of the Research: A Q-Methodological Study

Q-Methodology is a 'qualiquantological' (Stenner & Stainton Rogers, 2004) research method that aims to structure the identification and comparison of key shared and contested 'points of view' that surround a given issue or topic (Coogan & Herrington, 2011). Originating with British

[71] König (2004: 3) characterizes generic frames as "so pervasive that they can be used in almost any situation".
[72] Section 2.3.1 also offered an account of the conceptual basis of frame analysis

physicist turned psychologist William Stephenson in the 1930s (Stephenson, 1935, 1936a, 1936b), the technique has its roots in correlation statistics and an inverted variant of factor analysis. Q is used widely across the social sciences and has well-established precedence in studies exploring environmental perceptions and discourses of environmental concern (e.g. Cairns & Stirling, 2014; Capdevila & Stainton Rogers, 2000; Kalof 2000).

In Q-Methodology data is gathered in the form of Q-sorts: Participants sort a diverse set of statements about a specified topic onto a fixed and approximately normally distributed, single dimension and face-valid grid. They sort these statements according to what, relatively speaking, they themselves deem to be meaningful and significant. The data is then considered in terms of the entire configuration of responses produced by participants, in a by-person factor analysis. This shift in analytical focus (where the Q-statements become the study sample and participants, represented by an overall configuration of statements, are treated as the study variables and inter-correlated) is why the factor analysis in Q is referred to as 'inverted'.

In keeping with traditional factor analytic techniques, Q-Methodology aims to reveal patterns of association between the measured variables, and to generate a small number of factors that are used to help explain some of the diversity across participants' views and preferences. These characteristics essentially make Q a technique of data reduction, wherein the interpreted factors allow the researcher the opportunity to identify substantial portions of shared meaning within the data and to explore the dominant perspectives held in common by the participant group (Watts & Stenner, 2012; Webler et al., 2009, 2007). As Stevenson (1965: 281) explains, where a "Q-sort models a person's attitude of mind about a situation", the factors capture "attitudes of mind held in common by many people".

Providing the Q-sample is rich enough (i.e. the Q-statements are sufficiently well sampled), the method can be used to help explore subtle differences in viewpoints, allowing the researcher to explore dynamic and often shared characteristics among those in a sample. As well as clarifying differences between perspectives, Q may also identify less controversial dimensions of a debate, as well as areas of consensus, whilst promoting understanding of others' perspectives and facilitating dialogue (Donner, 2001; Eden et al., 2005). These characteristics make Q-Methodology a particularly productive analytical avenue in the exploration of highly contested or controversial topics, since it can be used to situate key bodies of knowledge pertaining to a given object of study within the context of others (Dryzek & Berejikian, 1993). Plus it can do this without bringing actors together into a potentially emotional and highly charged focus group setting (Danielson et al., 2009).

4.3.1 How Q-Sort Fits with the Research Paradigm

At first glance the quantitative features of Q could be deceptive and hide its typically critical and qualitative epistemology (Eden et al., 2005). Whilst today the method has diverse application (Robbins, 2005), through a research focus on 'subjectivity' Stephenson (1953) developed Q as an early challenge to Newtonian hypothetico-deductive methods in psychological traditions, which supposed that human beings were composed of a series of psychological 'parts' (Watts & Stenner, 2005a: 69). As discussed in section 3.5.1, this critique has since become typical of constructivist epistemology wherein people are argued to not passively 'see things as they are' in any kind of uncomplicated way (Watts & Stenner, 2012: 41), but rather knowledge is understood to be continually and actively constructed in an iterative cycle of meaning-making (von Glasersfeld, 1991; Reber, 1985). Despite its quantitative features Q-Methodology can therefore be perfectly at home in an interpretivist (social constructionism) paradigm, where it seeks to engage with the multiple and messy, socially and culturally situated subjective worlds in which people develop meanings of their experiences towards a given object of study (see Creswell, 2013).

The method is similarly compatible with the constructivist research paradigm cognisance that the researcher herself is a narrator (Elliot, 2005). Its execution is a highly interpretative process, requiring researcher judgement and interpretation at all stages. How the concourse is framed, which statements are used in the Q-sort, which participants are chosen to conduct the sorts, and the way in which the analysis is conducted, all shape the research findings (Webler et al., 2007). Participants are typically selected along more purposive qualitative rationales. Even in what may appear to be the most quantitative stage of a Q-analysis, some suggest that theoretical selection criteria "with due regard for any obvious contours in the data" (Brown, 1993: 116) should take precedence over statistical rationales when researchers decide which factors to retain and which to rotate (Eden et al., 2005; McKeown & Thomas, 1988).

Furthermore factors are just statistical abstractions until conferred discursive meaning through interpretation. Thus, from the factors generated, different researchers may construct subtly different meanings (Eden et al., 2005). The Q-methodology in this research is also coupled with qualitative interview techniques that add greatly to the richness of the data. The function of Q in this thesis therefore remains founded in interpretative discourse analysis (Webler et al., 2009) and the computer processing is merely used to facilitate and bolster the qualitative interpretation.

4.3.2 Designing the Q-Sort

This chapter will now detail the scope of the Q-study in this thesis and the main characteristics of its design.

4.3.2.1 The Boundaries of the Q-Study and the Sorting Instruction

Curt (1994) suggests that Q-studies should focus on *representations* of an issue, *understandings* of it, or *conduct* in relation to it, but that a study should never cross these boundaries. The sorting instruction in this study, shown in Figure 4.2 below, was designed to explore individuals' *understandings* of ocean fertilization as a response to anthropogenic climate change. Rather than asking participants to respond to the HSRC project per se, the sorting instruction was designed to ask participants to draw on their experience of this project and to use the Q-sort to consider and represent what the future of ocean fertilization means to them in more general terms. However the instruction was also designed to acknowledge that such imagined futures remain local and contingent (Curt, 1994; Watts & Stenner, 2012). Thus the sorting instruction was framed by the HSRC experiment since this was the event which initially sparked more concentrated reflection on ocean fertilization, and indeed on geoengineering more generally, in Haida Gwaii.

Figure 4.2 The Sorting Instruction

> "**Alongside the goal of salmon restoration, the Haida Salmon Restoration Corporation hopes to sequester carbon dioxide, through ocean fertilization, in order to reduce the scale of human-induced climate change. How do you feel about exploring ocean fertilization to try to sequester carbon dioxide in the ocean?** Please sort the provided statements in the order that best describes your point of view".

The sorting instruction was designed to be broad enough to capture a wide range of the contested discourse identified in phase one of the study, and to be as neutral as possible, to allow space for everyone to create their own meaning during the sorting exercise. It was also simply and clearly worded, to ensure that a wide range of participants were able to engage with it. This was important since, as Watts & Stenner (2012) point out, broadly speaking in a Q-study everyone needs to be answering the same question!

Feedback on this sorting instruction was sought from the HSRC directors. In some ways this feature of the design helped recognize the relational understanding of knowledge production and the benefits of collaboration in research processes. Pragmatically it was also important to ensure that the Corporation felt their project had been fairly represented in the Q-study, and the sorting instruction is the most obvious way in the data collection process that their project was framed by the researcher. It was imperative, for example, to avoid a scenario wherein HSRC participants were unable to identify with the relevance, or purpose of the sort, and became unwilling to participate in

the study[73]. It was also hoped that engaging the directors in the research design would provide the opportunity to share the objective of the exercise and to build trust with the HSRC, ultimately generating acceptance and support for the research.

4.3.2.2 Building the Concourse

Once the boundaries of the Q-study had been defined and the umbrella question constructed, the next step involved building the Q-set. A Q-set is usually text-based, and remembering that the Q-set serves the function of the study sample, Q-statements are constructed by the researcher to represent a spectrum of discourse "broadly representative of the relevant opinion domain" (Watts & Stenner, 2005a: 75). Compilation of the Q-set should therefore be informed by as many standpoints and themes as possible, and be balanced to an extent that anyone presented with the sorting instructions would feel able to sufficiently construct a personally meaningful representation of their understanding of the issue (Coogan & Herrington, 2011).

This requirement has implications for the number of Q-statements included in a study since clearly if a study contains too few Q-statements participants may start to feel frustrated, or limited in their ability to meaningfully express their point of view through the Q-sort. Further, as will be discussed below, on statistical grounds it is important to have more Q-statements than participants (Webler et al., 2007; Kline, 1994). Yet the number of Q-statements cannot be indefinite: Too many Q-statements will make the sorting process very cumbersome for participants and impossible to complete within a reasonable timeframe. Watts & Stenner (2012: 61) suggest 40 to 80 Q-items to be the right ballpark figure for balancing these requirements in Q-methodology[74].

Q-scholars typically assert that the Q-set should not be seen to contain any specific meaning until the participants themselves impress that meaning upon it through their sort (Watts & Stenner, 2012). This claim is difficult, if not impossible, to reconcile with the qualitative tradition of researcher reflexivity. But it is nevertheless the case that as participants engage with the exercise, the "qualitative detail" of a Q-methodological study will be "*filled out* as the study proceeds" (Watts & Stenner, 2005a: 76, original emphasis). Having a diverse group of participants and really listening to what people say is therefore more important than trying to cover absolutely every conceivable perspective in the Q-set. Consequently Donner (2001: 25) more conservatively conceptualizes the Q-set as "simply a subset of the possible concepts that may be important to this issue at hand".

[73] This was considered to be a risk since a number of the Q-statements were provocative in order to capture the range of opinion and encourage diverse reactions. The subset of the Q-sample that represented negative reactions to the project was expected to be difficult to reconcile with these participants given the perceived "media attack" on their project described by HSRC participants during interviews in phase one of the research.

[74] A colleague familiar with Q-sort recommended keeping the number of statements in the study to the lower end of this range, to ensure the exercise was not too unwieldy.

Background interviews are widely advanced within the Q-sort literature as a fruitful way of developing the Q-set (e.g. Barry & Proops, 1999; Webler et al., 2009). Another common approach is to construct the Q-set from secondary materials such as publications, websites, newspaper articles etc. (e.g. Brown, 2002; Robbins & Kruger, 2000; Webler et al., 2001). In this research these techniques were combined as the Q-set was developed from the frame analysis of the multiple lines of interpretative ethnographic enquiry that were pursued in phase one of the research. The Q-statements were thus designed to reflect themes identified in the first round of analysis.

Given its capacity to aid a systematic and comprehensive consideration of the research questions, the discourse analysis in this first phase of the research made use of Hedlund-de Witt's (e.g. 2012) IWF as both a tool to structure interviews and as an analytical lens through which to scrutinize the data. This framework therefore similarly informed the Q-set development. However in contrast to other very structured approaches to developing Q-sets that use concourse categories derived from theory (e.g. Dryzek & Berejikian, 1993; Hooker Clarke, 2002; Woolley & McGinnis, 2000), this research pursued a more fluid and interpretative approach to the Q-set sampling process. It therefore aimed to sample based on an understanding of the overall character of the subject, rather than according to a sample quota of predefined thematic categories. The Q-statement sampling process consequently took on what Watts & Stenner (2012: 60) describe as "an overtly crafty strategy".

Watts & Stenner follow Curt (1994) in describing Q-set development as a 'craft' and a creative endeavour. Although reflective of the interpretative conceptual framework, this terminology should not mislead. Like all artistic activities Watts & Stenner (2012) note that this 'craft' requires great rigour, patience and effort, and the Q-set will in the end be judged on its coverage and balance in the same way as a Q-set constructed in a more formally structured way. The Q-sort was refined following piloting with volunteers (n=5). Two of these volunteers were colleagues professionally familiar with the subject of geoengineering, who were felt well placed to comment on coverage, potential omissions and clarity[75].

The final Q-sample – 47 statements listed in full in Figure 6.1 in chapter 6 – was comprised of multiple possible answers to the sorting instruction statement, ordered using a random number generator (Random.org, 2013). As far as possible Q-statements were kept short, expressed a single idea, avoided qualifications and were communicated in language familiar to, and, where possible,

[75] The value of this piloting with colleagues should not be overstated since as highly-educated members of related research communities, as discussed by Gaskell et al., (1998), it is likely that their interpretation of the statements will reflect similar subcultural features to those of the researcher and thus will constitute a valid, albeit not universal interpretation of the articles.

used by, participants. Indeed a number of verbatim, or near-verbatim, statements from the corpus of data items were employed to better reflect some of the participants' own ways of structuring discourse (Dryzek & Berejikian, 1993; Webler et al., 2009).

The final set of Q-statements remained fairly ambiguous, since ambiguity gives participants the opportunity to interpret the statement in the context of their own preferences: A situation which lead Dryzek & Berejikian (1993: 59) to argue that Q is actually a more collaborative, democratic or even "egalitarian" method of analyzing public perceptions. "Ambiguity is resolved by each subject and reflected in his or her placement of a statement in relation to other statements", they attest (Dryzek & Berejikian, 1993: 51). A degree of ambiguity is therefore consistent with the *a posteriori* analytical approach outlined above wherein theoretically "there is little interest in the meanings which the investigator endows the statements, and consequently little interest in reliability. What is of interest, however, are the meanings and significance which participants attribute to the statements" (Brown, 2002: 9-10).

4.3.2.3 Participants: The P-Set

Selecting the number of participants with which to conduct the Q-sort also demanded some theoretical consideration. Sufficient participants to establish the existence of a factor and to illuminate and compare these factors are required in a Q-sort, but this may be achieved with a fairly small number of participants (Brown, 1980)[76]. Q-Methodology is not dependent on large numbers of participants since it does not aim to generalize findings to wider populations (Watts & Stenner, 2012) or to establish what proportion of these populations identify with one factor over another (Brown, 1980).

Q-methodology additionally does not employ large numbers of participants for reasons that are partly statistical. Conventional factor analytic processes demand that studies feature at least twice as many participants as variables (Kline, 1994). In statistical terms participants are the variables in Q-methodology, which implies that a Q-set should feature at least twice as many Q-items as participants. Q convention therefore denotes that, at a minimum, the analysis must have a smaller number of Q-participants than Q-statements (Watts & Stenner, 2012) and a ratio of 1:3 is typically advocated (Webler et al., 2007). Moreover, given the importance of collecting supporting qualitative data to assist with factor interpretation (see below), large numbers of participants can also "easily negate many of the subtle nuances, complexities and hence many of the essential qualities contained in the data" (Watts & Stenner, 2005a: 79).

[76] Webler et al. (2009) suggest researchers can typically expect to find between 2 and 5 social perspectives within a Q-analysis and that at least 4 to 6 Q-participants are needed to define each perspective; although this is purely theoretical, not least since it is impossible to predict who will define a factor.

The participant group composition required careful consideration. A Q-study should be focused on a segment of society whose perspectives the researcher is interested in learning about. Q also works best when diversity of opinion is maximized among the participants, since *theoretically* participants are selected to represent the breadth of opinion in the population, rather than the distribution of beliefs. A good P-set is therefore always more "theoretical or dimensional… than random or accidental", Brown (1980: 192) explains. Following analysis in phase one of the research, the I was well placed to purposively select participants to complete the Q-sort, who would both add unique perspectives to the study and who were sufficiently interested and engaged with the subject to be able to do so effectively[77] (Brown, 1980). Thus the convenience, snowball and purposive sampling pursued at the start of phase one of the research firmly became more purposive in phase two.

Not everyone who had already generously committed their time to the interview process was necessarily available to participate in the study further. The Q-sort also demanded literacy skills from participants which, in a notable limitation of this stage of the research, precluded the further participation of a small number of others. Thus as shown in the participant list in appendix 4.1, in addition to the participants sampled from stage one of the research (n= 22), a small number of further participants (n= 4) were chosen to participate to 'fill the gaps' created by participants who were unable to contribute in this second stage of the research. This gave a total of 26 participants. As in phase one of the research, the sampling strategy also sought to ensure that Q-sorts were gathered from all of the obviously pertinent demographic groups; although there was no expectation that the emergent factors would respect these boundaries.

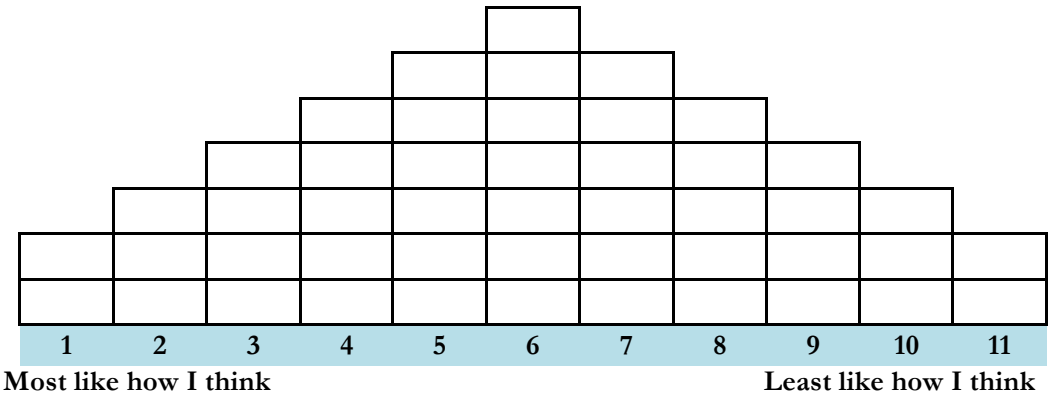
4.3.3 Doing the Q-Sort

Q-methodology requires that data be collected in some kind of standardized distribution. Most commonly this takes the form of Q-statements sorted onto an approximately normally distributed grid. While Brown (1980) attests that the shape and kurtosis of the distribution is almost irrelevant to the factors that emerge from a study, a normal distribution is standard practice in Q-methodology. As illustrated in Figure 4.3 below, the study used a grid with an 11-point (approximately) normal distribution on which to rank the Q-statements. Q-participants in previous studies have reported finding such a distribution restrictive, since it demands that they rank small groups of statements similarly when they may feel a need to distinguish between them (Watts & Stenner, 2012). A flatter distribution would allow participants to make more fine-grained distinctions about the Q-statements they feel most strongly about. But equally steeper distributions can prevent participants from feeling overwhelmed by the number of decisions that they have to

[77] Whilst phase one of the research facilitated a more open and explorative engagement with the research process, Q-methodology generally requires that participants have a fairly well developed perspective on the research subject. A 'well-developed' perspective should not be understood as an expert perspective. Rather an ideal participant is someone who has given the issue significant personal thought and is engaged and interested in the subject matter (c.f. Cairns & Stirling, 2014).

make, and can help avoid participants having to make unnecessary decisions that yield no additional information (Watts & Stenner, 2012). Watts & Stenner's (2012: 80) recommendation that an 11-point distribution be assigned to Q-sets numbering 40 to 60 items was felt to be a suitable compromise of these tradeoffs.

Figure 4.3: The Q-Sort Matrix



Q-sort grids are typically numbered from a negative value at one pole through to an equivalent positive number at the other pole (in an 11-point distribution these run from -5 to +5). However this numbering is another medium through which participants can feel unduly restricted through the Q-sort process: They may feel forced to allocate a positive ranking to an item they disagree with and visa versa (Watts & Stenner, 2012). In stark contrast to Lickert-scale approaches, in Q-Methodology participants score the Q-statements relative to each other, meaning the rankings have no absolute meaning and the middle point on the distribution chart (indicated by 0) is not equivalent to expressing no opinion. The inherent relativity of the exercise was therefore emphasized to participants and on the Q-sort grid used by participants the positive and negative rankings (-5 to +5) were replaced with a positive continuous scale, running from 1 to 11.

4.3.3.1 Conducting the Q-Sorts

Most of the Q-sorts were conducted in person using a printed distribution chart and numbered printed Q-cards of a standardized appearance. This is generally argued to be the most engaging Q-sort format (Donner, 2001). After introducing the aims of the research and completing the necessary ethical formalities (see below), each participant was given a blank copy of the sorting distribution, a written copy of the conditions of instruction and the 47 Q-statement cards[78]. The conditions of instruction were also detailed verbally and participants were given the opportunity to clarify anything about the task that they did not find clear.

[78] Copies of these are shown in appendices 4.9 and 4.10.

Participants were asked to begin by reading all of the Q-statements and sorting them into three piles: Those they felt reflected their perspective, those they felt did not reflect their perspective and those about which they feel less strongly, indifferent, or unsure. Taking first the pile of items that the participant had indicated identifying with, and setting the other two aside, the items were then spread out in front of the participant. They were then asked to begin sliding the items they found most meaningful and reflective of their perspective to the right, and those they felt were a little less significant to the left. After visually creating space between the statements in front of them they were then asked to iteratively populate the grid, allocating the statements to rank values.

The point at which this first set of items ended on the grid was noted: A step which proved useful in later analysis when trying to define perspectives during factor interpretation. Targeting the left-hand side of the grid, the process was then repeated in reverse for the pile of statements the participant had indicated did not reflect their thinking. The middle of the distribution was then completed in a similar manner. When the whole grid had been populated, participants were offered the opportunity to reflect on the grid and make adjustments if necessary, before I recorded the completed sort on a blank data record page (see appendix 4.11).

The Q-process built on the qualitative roots of the research by asking participants completing the sort to 'think out loud' and to reflect on the decisions that they were making during the process. After the sort had been completed, while recording the results I had the opportunity to inspect the sort. In a kind of post-sort interview I then inquired as to the significance of particular items and their meanings to the participant. Starting first with the extremes of the distribution, participants were then asked whether any items in the middle of the sort were particularly important to them. Explanations for any unusually placed or outwardly anomalous statements were also sought. This discursive dimension to the Q-sort added richness to the data and helped me interpret factors in a more holistic fashion. The Q-sort interviews were recorded and transcribed verbatim for analysis.

In order to offer some content validity to the concourse and Q-sort, participants were also asked whether they felt any important ideas had been omitted from the Q-statement sample. Any affirmative responses were met with the request that participants create the new item(s) that they would have liked to have been included in the sort. Provided with similarly sized pieces of card, participants were then asked to add the item(s) onto the column in which they would have placed it. Whilst these items were not included in the statistical analysis, these items were recorded and could provide insight for the subsequent interpretation of the factors.

Detailed formally structured pre-sorting information was not gathered in this research, but rather, such information was often acquired through more informal conversations held before and after

the sort[79]. Within these conversations factors such as age, occupation, ethnic identity and other personal information were often established, which helped enrich interpretation of the resulting factors. This more informal approach to obtaining such information was felt to be more conducive to building natural relationships with participants, and it was arguably more collaborative, since it allowed participants to reveal the information that they themselves felt was important for me to know. The entire Q-sort process tended to take each participant between an hour and an hour and a half to complete.

4.3.3.2 Online Q-Sorts

Whilst the researcher being present and actively facilitating a participants Q-sort is generally considered a preferable method of data collection, in this study a small number of participants expressed interest in completing the sort, but were unavailable to meet in person during the time available. Combining Q-sorts collected in-person with Q-sorts collected online has been done successfully in previous studies (Cairns & Stirling 2014; Gruber, 2011), and so an online Q-sort application was developed to facilitate this participation using the software FlashQ.

The functionality to customise an online, post-sorting, open-format questionnaire, to stand in for the post-sorting interview, made FlashQ a good choice of software. The FlashQ code was downloaded from http://www.hackert.biz/flashq/home/ and the software was integrated into a custom HTML website hosted on Google App Engine at http://oceanfertilizationhaidagwaii.appspot.com/ (see appendix 4.12 for a representative series of screenshots of this process). A total of 3 of the 26 participants completed their Q-sort through these means.

4.3.4 Analyzing the Q-sort

In Q some methodological decisions may be taken as part of a reflexive analytical process that responds to the emergent data set. In other words the methods final application must be reflexively and consciously worked through in reaction to the data (Eden et al., 2005). A number of specific methodological and analytical choices will therefore be detailed in the Q-study results chapter. But for now this chapter will briefly offer an overview of the Q-methodology analytic process.

4.3.4.1 Centroid Factor Analysis

Q-methodologists typically use PQMethod to run their by-person factor analyses, and this study followed this convention. PQMethod is free, purpose-built Q-software that allows researchers to intercorrelate the overall configurations of participants' statement rankings to measure the similarity of each participant's Q-sort with every other Q-sort. Q-methodology convention denotes the use

[79] Such information was acquired through the same means in phase one of the research.

of centroid factor analysis in Q-methodology, and thus this is the only factor extraction technique available in PQMethod. Principle component analysis (PCA) is another form of data reduction and extraction that is available within PQMethod. Whilst tending to produce a similar output to centroid factor analytic processes (Harman, 1976), the PCA method often includes substantively irrelevant factors as it attempts to explain all variance. PQMethod does not allow you to remove these from the analysis.

This mathematically 'optimal' solution might appear enticing to researchers grappling with the complexities that surround decisions about which factors to retain and which to rotate. However constructivist Q-methodologists tend to prioritise solutions that are deemed the most substantively or theoretically meaningful and coherent over mathematical rationales (Watts & Stenner, 2012). Varimax rotation (discussed below) is a centroid factor analytic technique that allows a mathematically optimal solution to be resolved later in the analytic process. Thus Q-methodologists tend to prefer centroid factor analytic techniques that permit decisions about a 'best' solution and the best criteria for making that decision to be delayed pending full investigative exploration of the data, and its possible solutions (Watts & Stenner, 2012). For this reason, as detailed in chapter 7, while the results of principle component analysis were explored, this research pursued a centroid factor analysis.

4.3.4.2 Factor Extraction and Rotation

Centroid factor analysis does not resolve itself into a single acceptable factor analytic solution and instead researchers must make decisions about which factors to retain and rotate. To be retained factors must generally meet some basic statistical criteria. For example factors with an Eigenvalue (a measure of explanatory power) of less than 1 do not satisfy the Kaiser-Guttman criterion (Guttman, 1954; Kaiser, 1960) and are often not retained. Similarly factors generally need to have at least two significant loading participants to facilitate the creation of factor estimates. A successful Q-study also needs to account for a reasonable portion of the range of meaning and variability present within the study (the study variance). As important in deciding which factors to retain, however, is that a solution makes good 'sense' of the data (Watts & Stenner, 2012).

The position of individual Q-sorts is completely and permanently fixed relative to other Q-sorts within the factor space (the conceptual space that is defined by the extracted factors). However these sorts can be viewed in different ways and from different angles through factor rotation. In the words of Watts & Stenner (2012: 142), this is "the system by which we ensure that each factor offers us the best possible, or most meaningful vantage point from which to view our subject matter". Factor rotation may be done using the varimax function within PQMethod, which will rotate the factors according to statistical criteria in order to maximise the total amount of study

variance explained. It is also possible to perform further manual or 'by-hand' rotations, which may be particularly appropriate in studies employing an openly deductive approach to analysis (Watts & Stenner, 2012) or where a study is seeking to uncover minority perspectives (Brown, 2006). The decision-making processes through which I decided which factors to retain and rotate in this research are detailed in section 7.1.

4.3.4.3 Factor Estimates and Interpretation

Factor loadings produced following rotation measure a participant's affinity to a factor and denote the extent to which their sort exemplifies that factor. Those participants that ranked the Q-statements similarly and have statistically significant factor loadings are 'flagged' in PQMethod and used in the construction of factor estimates[80]. To calculate these estimates the contribution of each of the statistically significant sorts to a factor estimate is weighted according to its factor loading. To permit cross-factor comparison, these total weighted scores are converted by PQMethod into standardized z-scores.

From these z-scores an exemplifying Q-sort is generally then produced. Taking the form of a single Q-sort, this 'ideal-typical' sort forms an estimate of the Q-statement item configuration characteristic of participants that load significantly onto each factor. It is presented in the array format in which the data was originally collected. Partially triangulated and enriched by the qualitative data collected alongside the sort, this estimated array is then used to construct a narrative interpretation of the viewpoint, which forms the primary output of the Q-sort analysis.

4.4 Ethics and Critical Reflection on the Role of the Researcher

Conducting research ethically is an important social research quality criterion for both Robson (2011) and Kushner (2005). For Robson (2011: 15) "ethically means that you follow a code of conduct for the research which ensures that the interests and concerns of those taking part in, or possibly affected by, the research are safeguarded". The host institutions *The University of East Anglia* and *King's College London*, as well as the research funding body, the UK *Economic and Social Research Council*, have their own ethics policies and procedures, which I was obligated to abide by (UEA, 2012; KCL, 2015; ESRC, 2015). Chambliss & Schutt (2010: 44) reflected the fundamental components of these policies when they proposed that to be ethical researchers must "1) Avoid harming research participants. 2) Obtain informed consent. 3) Avoid deception. 4) Maintain privacy and confidentiality".

[80] The equation $2.58(1/\sqrt{n})$ where n = the number of statements in the Q-set was used to calculate statistical significance at the 99% confidence level.

In keeping with these obligations, protocols for ethical research were carefully devised in advance of the fieldwork[81]. Indeed many of the steps taken to maintain these standards have been detailed earlier in this chapter: The decision to discontinue focus group methods of data collection and the provision of sufficient information about the research to facilitate the acquisition of participants' informed consent being two obvious examples. However as Watt & Scott-Jones, (2010: 123) suggest, "to an extent, most field research requires a more flexible or situational approach to ethics, and it is naïve of any researcher to assume that an overt role, combined with signed informed consent forms, means that the research is ethical". To conclude this chapter, it therefore feels appropriate to offer some further brief critical reflection on some of the ethical issues that surrounded this research methodology.

I have taken great care to position this thesis within constructivist traditions, which understand that researchers cannot avoid bringing themselves to their research and that the 'writing up' of research is in itself a political act (Christie, 1992). This need not be seen as a shortcoming of social research. Indeed the very strength of ethnography comes from the opportunity to develop knowledge from meaningful connections and relationships, and the creative processes that this tradition makes possible can in themselves become deeply meaningful (Scott Jones, 2010b). Yet by recognising the inevitability of such prior knowledge, experience, context and privileges, ethical concerns about power and representation became central to ethnographic work (Scott Jones, 2010b). These concerns form the basis of this final section.

4.4.1 "Can There be a Feminist Ethnography?"

Stacey (1988: 22) is among a group of scholars who have argued that the apparent 'mutuality'[82] and reciprocity of ethnographic research risks leaving participants exposed to a "deeper, more dangerous form of exploitation" than is seen in more conventional research methods. For Stacey (1988: 21) fieldwork represents an intrusion into the lives and relationships of participants. As the researcher is far freer to leave than the participants, the researched are subject to far greater risks of "exploitation, betrayal and abandonment" than they are in much positivist research. Further the "ethnographic method appears to… place the researcher and her informants in a reciprocal quest for understanding, but the research product is ultimately that of the researcher" (Stacey, 1988: 23).

Some of Stacey's concerns are difficult to reconcile. Whilst I asked, and typically received, a great deal of openness from my research participants, I was demonstrably less candid with my own views. This lack of openness was itself partly for ethical reasons: I did not wish to take a public

[81] See appendices (4.13-4.16) for an example interview information sheet and consent form and an example Q-sort information sheet and consent form. Notably, in keeping with the 'flexible' research design, as the nature of the interview protocol was iteratively developed, these forms also went through several iterations.
[82] For Fabian (1995: 47) ethnographic mutuality is "the promise of nontrivial understanding that is produced by researcher and researched together".

position that risked exacerbating tensions and possibly harming participants in the field setting. However this silence speaks to an implicit power differential between the researcher and the researched. I also feared at times that through this silence I risked inauthenticity. Contradicting or challenging participants was not easily conducive to elicitation, which largely prevented me from doing this. However at times I myself had powerful emotional reactions to information that participants shared with me and I suspected my silence was interpreted as agreement or approval. There was also a fear that my silence would be construed as apparent endorsement of the HSRC project. 'Scientists' can carry strong rhetorical power and I believe my identity and presence was at times used to legitimate and sanction the HSRC's experiment.

In section 4.2.3.1 I described feeling profound friendships and emotional connections with many participants. However this notion of friendship between the researcher and the researched has also been criticised by scholars who argue that researchers effectively "exploit… this intimacy as an investigative tool" (Amit, 2000: 3, see also Burke, 2007). As Stacey (1988: 23) writes, "the exploitative aspect of ethnographic process seem unavoidable. The lives, loves and tragedies that fieldwork informants share with a researcher are ultimately data". In light of feminist principles of trust and collaboration with their research participants (Oakley, 2005), such ethical challenges leave Stacey (1988: 21) asking, "can there be a feminist ethnography?"

4.4.2 Partnerships, Representation and Authorship

In light of the concerns raised by Stacey (1988) and others, careful reflection on representation and research relationships was necessary to ensure the ethical integrity of the research. As outlined, the research pursued a flexible design, which was intended to be responsive to the diverse knowledges and priorities that each participant brought to the research. I hoped this would help me to work *with* participants and to facilitate more personally meaningful participation within the fieldwork. During the research there were some encouraging signs that suggested that with some participants at least a degree of reciprocity was established. "*This is helping me, because I'm so confused right now. It's good to think about stuff*", Participant Brent Morton described. To maintain the values of sharing and respect (c.f. Hart, 2010), moving forwards it will also be important to find meaningful and accessible ways to feedback my research to the community[83].

I similarly sought to engage participants in the analytic process. I often conducted interviews across multiple encounters with participants. This afforded me the opportunity to seek clarifications and to a degree to 'member-check' my interpretations, which offered greater rigour to my analysis and

[83] I plan to return to Haida Gwaii in early 2016 and will seek fora through which to re-engage participants with my research output. I also feel compelled to attempt alternative and more accessible ways of writing about this project and in keeping with the story-telling culture of Haida oral history, have considered attempting a work of creative non-fiction. Having never undertaken such a project I am not yet sure of my abilities in this area, so the success of such an output is far from guaranteed.

helped ensure I constructed as meaningful a representation as possible (Long & Johnson, 2000). I have also heavily interspersed direct quotations in the write up of this research in the hope of conveying more palpable expression of participants' meanings. Throughout this thesis these original quotations from interview and focus group participants are italicized.

Writing self-reflexive memos throughout the analytical process to document my thinking processes and to reflect on the ways in which other literatures and existing concepts and theories may have been shaping my emerging interpretations was also an important dimension to analysis (Charmaz, 2006; Glaser, 2004; Thornberg, 2012). By writing these down the linkages between these ideas and the emerging analysis could be reflexively explored. Self-consciously reflecting on the ways in which my own subjectivities and identity could have shaped the research process and output was another important dimension to ensuring the research integrity (c.f. Davis, 1999; Okely, 1992). Brewer (2000, 1990) particularly has written about some of the dynamics that surround young female researchers in immersive field settings, for example. During the interview process I was treated variously in ways that suggested participants perceived me in such terms as a friend, an equal, an expert, an 'acceptable incompetent' (Lofland, 1971: 100), a critic, and a potential partner. Some of these scenarios presented challenges, others advantages, but since such dynamics inevitably shaped the interactions, being aware of these various perceived roles and thus being better equipped to respond appropriately to them, was an important dimension to my fieldwork.

Regardless of all these steps taken in the hope of developing an account that carries as much resonance as possible for the participants that contributed to my research process, ultimately it is fundamental to recognize that in the words of Stacey (1988: 24) this work "is not cultural reportage, but cultural construction… [and] a construction of self as well as of other". There is a torrid history of outside voices attempting to speak for Indigenous cultures and at times during this research participants expressed deep concern about the potential for Haida cultural practices and understandings to be misrepresented in this research also. In the words of Donna Haraway (1997) in this research I therefore aspire to be a "Modest Witness" seeking awareness of my own biases and position. And, echoing James Clifford's (1986: 1) notion of "partial truths", I aim to offer 'situated glimpses' (Rose & Gilbert, 2005; Howitt, 2001; Howitt & Suchet-Pearson, 2006) into the research questions that, "however fleeting, are possible and can be profound" (Scott Jones, 2010a: 10). Deliberate use of the first person at various points during this thesis is an intentional ploy to help convey these limitations.

Chapter 5: "40 Million Salmon Can't Be Wrong". An Account of the Haida Salmon Restoration Corporation's Ocean Fertilization Experiment

5.1 Situating this Chapter

On October 15th, 2012 the UK *Guardian* newspaper brought news of the Haida Salmon Restoration Corporation's (HSRC) ocean fertilization experiment to the world stage. "A controversial American businessman dumped around 100 tonnes of iron sulphate into the Pacific Ocean as part of a geoengineering scheme off the west coast of Canada in July" the article started (Lukacs, 2012). A flurry of related newspaper articles from predominantly Canadian publications then emerged. These began detailing how during July and August of 2012, from the back of a black-cod fishing boat known as *The Ocean Pearl,* the HSRC had tipped 120 tonnes of iron sulphate and iron oxide into an ocean eddy in international waters off the west coast of the British Columbian archipelago Haida Gwaii. The HSRC it emerged was formed through a union between Old Massett Village Council (OMVC), a First Nations band council representing Haida residents of Old Massett on the islands of Haida Gwaii, and Russ George, an American entrepreneur best known for founding *Planktos Inc;* an enterprise with a controversial history of carbon credit ventures[84].

This first empirical chapter offers a critical account of this ocean fertilization project. It seeks to analyse the wider context and circumstances that lead to the project, to explore the significance of place, and to situate the HSRC within local experiences and histories. In many ways this chapter is an attempt to reflect and respect my very privileged position as the only researcher to date to have been given the opportunity to undertake an in-depth study of the HSRC project using the lens and tools of ethnography and geography[85]. To use language I encountered at the 2013 Skidegate potlatch held in the George Brown Recreation Centre to celebrate the 2013 Haida Gwaii Legacy Pole raising at Windy Bay, I wish to honour my role as a witness of this business[86].

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[84] With the expressed vision of "removing CO2 from our oceans and atmosphere by healing the seas, growing new climate forests, and erasing carbon footprints" (Planktos, 2014), Planktos had previously attempted to conduct ocean fertilization experiments near the Galapagos and Canary Islands, leading to clashes with Greenpeace (Porter, 2012). Controversy surrounding certification of an unplanted Vatican forest brought George further notoriety (CBC, 2013).

[85] Notably Buck (2014a, 2014b) also made a useful contribution, following a much shorter visit to Haida Gwaii.

[86] I was lucky enough to be on island during the 2013 Haida Gwaii Legacy Pole raising at Windy Bay. The first pole raised in Gwaii Haanas National Park for over 130 years, the pole was raised to honor those Haida who successfully defended South Moresby Island from clear-cut logging in the 1980s, to commemorate the establishment of the national park and 20 years of co-management through the Gwaii Haanas agreement and to celebrate the resilience and strength of Haida culture that was so poignantly symbolised in this event. In the celebrations that followed this historic occasion, a potlatch lasting from the afternoon until late into the night was held. As is typical of this traditional practice, everyone on island was invited to 'witness' this historic Haida 'business'. Thus the George Brown Recreation Centre in Skidegate was filled to almost bursting with people, Haida and otherwise, from the seven main communities on Haida Gwaii; plus a host of visitors to the islands. One of the many traditional practices banned under the oppressive 1884 Potlatch Law,

This interest in venturing into the 'lifeworld' of the HSRC project also relates to the wider aims of my thesis which seeks to pursue a more situated engagement with geoengineering in keeping with geographical traditions. I aim to identify some of the general characteristics and relationships surrounding the project, while describing and interpreting the events and circumstances that motivated support and resistance to the project and that contributed to its various interpretations. I hope that engaging with people, practices, objects, representations and "local dialects of nature" (Smith, 2013: 155) will allow me to develop a more meaningful insight into the researched's social worlds and into lived experience of the HSRC. In the process, this chapter intends to illuminate some of the cultural and social specificity to the narratives of 'nature' and human agency in ocean fertilization discourse that the remainder of this thesis is concerned with.

But before this analysis commences I must reiterate a word of caution. I have gone to great lengths to stress the necessary collaboration between the researcher and research participants in the production of ethnographic knowledge and to deconstruct the notion of a researcher as a detached and neutral observer. Indeed I hope I managed to further the argument that this dualism is neither feasible nor desirable, whilst highlighting how the fallacy of impartiality has at times produced geographical research on Indigenous peoples that by disempowering, colonizing and hiding alternative knowledges, has been distinctly neo-colonial.

This research is the product of diligent and in-depth study of the HSRC project, using data collected over a period of 18 months. Through the inherently social experience of ethnography (Amit, 2000), during this time I sought and generously received guidance from many people in the HSRC and on Haida Gwaii who shared their thoughts and experiences in deep and personally meaningful ways. These people have greatly informed the contents of this chapter and for their time and commitment to my research process I am deeply grateful.

Yet reflections on the challenges of telling a story as an outsider, and the poignancy of this in a First Nations context, are nowhere more relevant in this thesis than they are in this chapter. Thus, while I hope to acknowledge some of the many stories told and to report my findings in a way that has salience for those who have contributed to this research process, I must also reiterate that through this account I make no claim to representing the HSRC, the village of Old Massett in

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the Haida potlatch complements the customarily oral nature of Haida culture, allowing everyone invited the chance to witness major changes in society (Halpin, 1984). Between the lengthy but vibrant business of the potlatch, which included speeches, and performances of dance and songs, guests were rewarded handsomely for attending the event, with a feast of endless freshly harvested sea food and enough leftovers to take home. But with these gifts, came the explicit duty to witness this monumental business, and to share the story of the Legacy Pole with others. Having born witness to the project of the Haida Salmon Restoration Corporation, I hope I have not stretched this lesson of the Legacy Pole potlatch too far in my commitment to tell of this business too.

which this project unfolded, or indeed anyone else in Haida Gwaii. Haida people have shown themselves to be as capable of speaking for themselves as anyone, and far more so than most. As Cree member of the Indian Residential Schools Survivor Committee Eugene Arcand powerfully spoke to the Truth and Reconciliation Commission Forum in 2011, First Nations people "don't need help archiving anymore" (Arcand, 2011). In time I suspect Haida voices will step forward to provide a much more fluent account of this project and its significance for the village of Old Massett. When they do, I for one will be ready to listen.

5.2 Physical Geography

I will start this story by clarifying the *where*. The iron in the HSRC's ocean fertilization project was deployed 284 miles west of the British Columbian islands of Haida Gwaii[87]. Haida Gwaii is an archipelago of around 350 islands located approximately 100 kilometers from the North-West Coast of British Columbia (Lee, 2012). On a clear day Alaska can be spied from Haida Gwaii's Northern tip. Widely branded the "Galapagos of the North" the islands form a celebrated ecosystem, noted for their biodiversity, physical beauty and natural resource abundance.

Haida Gwaii is the traditional home of the Haida Nation, and while the Haida have never signed a treaty or seceded their rights to Haida Gwaii, following European contact in the 1700s the economic value of local resources lead others to settle and lay claim to the islands and their bounty. As of 2011 census figures, Haida Gwaii has a population of approximately 4,370 people (Observer, 2012a), roughly half of which identify as ethnic Haida (Kennedy et al., 2014). There are eight notable settlements on Haida Gwaii which, starting from the most Southerly, are known as Sandspit, Queen Charlotte City, Skidegate, Tlell, Port Clements, Masset, Old Massett and Tow Hill. Most of these are identified in Figure 5.1 below.

[87] The HSRC report deploying most of the iron at a position of 52 degrees 50' N, and 139 degrees 50' W, putting the iron about 284.1 miles west of Frederick Island; the most westerly point of Haida Gwaii. They then moved further west (~140 deg. W) to spread another smaller patch. According to (Bird et al., 2013) this comprised 90 tons of iron sulphate deployed between 22nd and 30th July 2012, 10 tons of iron oxide deployed on 16th and 17th of August and then a mix of 10 tons iron sulphate and 10 tons iron oxide spread on the 18th and 19th of August.

Figure 5.1: Map of Haida Gwaii

(Obtained from Sun Stones, 2014)

This relatively remote island location might seem an unlikely site for a project branded the world's 'largest geoengineering experiment' by media outlets (Lukacs, 2012; McKnight, 2013a). But to begin understanding how in the summer of 2012 the HSRC came to be slowly drizzling a burnt orange iron dust dissolved in seawater into the Pacific Ocean, we must start with the tale of a volcanic eruption and a salmon run.

5.3 The Haida Salmon Restoration Corporation is Born

In August 2008 Kasatochi volcano, on a little known island in southwestern Alaska, began erupting an ash plume that reached 45,000ft and many hundred kilometres wide (NASA, 2014). Academic literature linked large phytoplankton blooms in the subarctic North Pacific, observed following the volcano, with "fertilization of this normally iron-limited region by [volcanic] ash" (Hamme et al., 2010: 1; see also Langmann et al., 2010). Between the early 1990s and 2009, sockeye salmon in British Columbia's Fraser River had experienced a sustained decline in productivity, sparking the establishment of the Cohen Commission (Cohen, 2012a). Yet in 2010 the Fraser River saw it's largest run of sockeye since 1913: 34 million salmon returned, compared to 1.7 million the year before (Parsons & Whitney, 2012). An opinion piece by Parsons & Whitney (2012) presented the hypothesis that these plankton blooms contributed to the strong 2010 sockeye run, through increased food availability ensuring greater survival of the juvenile salmon.

The HSRC tied this hypothesis in with work suggesting that a decrease in iron-rich natural dust deposition in the ocean was due to anthropogenic climate and land-use change (Maher et al., 2010; Mahowald & Chao, 2003; Sun et al., 2001; Xiao et al., 2008). Their business development rationale followed that, because ocean phytoplankton has also been reported to have declined over the past century (Boyce et al., 2010), the declining sockeye runs witnessed along the British Columbian coast could be at least partially attributed to a shortage of iron in the ocean (HSRC, 2014a). For the HSRC, supplementing that iron through ocean fertilization – giving the ocean "*a vitamin*" in the words of one HSRC affiliate (Participant Rob Peters) – felt like the logical conclusion. "Buy Mother Nature one cheap cocktail a month, and you've taken care of her. It's part of the solution and it also heals the harm that's done", former chief scientist Russ George attested (CBC, 2013).

As will be discussed in section 5.6.3 of this thesis, salmon are of fundamental cultural and nutritional value to Old Massett and previously formed an important part of the Old Massett economy (section 5.6.5). But salmon restoration was not the only goal of the HSRC. Ocean iron fertilization has also attracted interest in the geoengineering literature, where its potential to remove carbon dioxide from the atmosphere through "large-scale manipulation of Earth systems" has been debated (Royal Society, 2009: x)[88]. A CDR form of geoengineering, here the intention is similarly to stimulate algal growth in the ocean environment, encouraging photosynthesis. But for geoengineering the focus is on absorbing carbon dioxide in the deep ocean – the largest active carbon sink on Earth – in the form of particulate organic carbon (Lampitt et al., 2008).

Science suggesting that ocean iron fertilization could sequester carbon dioxide in significant volumes and with any permanency is highly contested and relatively undetermined, since

[88] See also Aumont & Bopp, (2006), Boyd, (2008b), Buesseler et al., (2008), Cullen & Boyd, (2008), Lampitt et al., (2008), Wallace et al., (2010) and Williamson et al., (2012).

monitoring is very difficult and expensive (Cullen & Boyd, 2008; Boyd et al., 2007; Buesseler et al, 2008; Williamson et al., 2012). In the 2009 Royal Society report "Geoengineering the Climate", one of the most comprehensive assessments of geoengineering techniques to date, authors scored the likely effectiveness of ocean fertilization as 'low', suggesting it to have a "likely low long-term carbon storage potential" (Royal Society, 2009: 18). Furthermore, while on the basis of their 2004 experiment Smetacek et al., (2012: 313), suggest that "iron-fertilized diatom blooms may sequester carbon for timescales of centuries in ocean bottom water" and at rates found in natural blooms, other experiments and studies have largely echoed the Royal Society report, offering inconclusive findings or suggesting long-term sequestration of carbon to the deep ocean to be ineffective (e.g. Aumont & Bopp, 2006; de Baar et al., 2008; Boyd et al., 2007, 2004, 2000; Buesseler et al., 2004; Coale et al., 2004; Tsuda et al., 2003).

The Royal Society report similarly offered little support to the idea that ocean fertilization could be advantageous for ocean food webs, such that increased productivity could support larger fish, mammal and invertebrate populations. Noting instead the complex tropic structures typical of ocean food webs, and experiences with eutrophication in estuarine and freshwater systems, the report classified the safety of ocean fertilization as 'very low', stating a "high potential for unintended and undesirable ecological consequences" (*i.bid,* see also Buesseler et al., 2008; Jones, 2011). Similarly the Parsons & Whitney (2012) hypothesis linking the 2010 salmon runs with the 2008 Kasatochi volcano remains highly contested (e.g. McKinnell, 2013a).

As is perhaps best reflected in the lyrics of the song "40 Million Salmon Can't be Wrong" written by Russ George (George, 2013a) and in guarantees of saleable carbon credits from carbon sequestration, these uncertainties did not stop the partners in *Planktos Science* championing these linkages to Old Massett (see Box 5.1). Instead the project promised to serve as meaningful action to address the threat of climate change, to revive local salmon runs and to generate a guaranteed CAD$29 million profit from carbon credit sales by the end of operations year 2 (White, 2011). On the basis of these claims on March 25th 2011, 66% of the 168 Old Massett residents that turned out to vote elected to invest CAD$2.5 million of band funds into financing the project[89] (OMVC, 2011). Promises of proprietary knowledge secured George a 48% stake in the HSRC, a place on the board of directors and the title of Chief Scientist (Vancouver Registry, 2014), while Old Massett Village Council retained the remaining 52% of the company.

[89] 50%+1 votes were required for the financing to be approved (OMVC 2011).

"*We had electronic instruments running the whole time and we had gliders running a lot of the time. And we took chemistry samples all of the time that we were out there. So based on that and the previous work done by Smetacek and Boyd and the rest of the crew, we will be able to add those up and turn those into a number, which will be verifiable, because we are just going to follow standard protocol. It'll have to be verified by someone who is an expert, like Smetacek or Boyd or whoever it happens to be and once that number is verified we will take it to another third party. This is the way the carbon industry works, we will take it to another third party and they will go, 'yeah, check check check, this box, this box, this, box, good, good, good, done' and they will put their certification stamp on it*"

– Participant Rob Peters

Box 5.1

5.4 The HSRC Project Becomes 'Geoengineering'

"World's biggest geoengineering experiment 'violates' UN rules"
- The Guardian (Lukacs 2012)

"Iron dumping done for mainly for financial gain, group claims"
- Vancouver Sun, (McKnight, 2012)

"Iron dump highlights need for global rules, Canada tells UN delegates"
- Globe and Mail, (Moore 2012)

"Ottawa attacks Haida's 'rogue science' experiment"
- Vancouver Sun (O'Neil & Moore, 2012)

"Maverick behind iron dump in ocean is dropped"
- Vancouver Sun (McKnight, 2013b)

"Geoengineering guru lied about B.C. ocean fertilization"
- The Vancouver Sun (Moore, 2014a)

Box 5.2

As discussed in section 2.1, in the several years preceding the experiment technologies under the meta-label 'geoengineering' had attracted increasing interest in academic, media and political domains, as a partial solution to concerns about anthropogenic climate change (Porter & Hulme, 2013). Yet as a result of the assessments of ocean fertilization discussed above, while the HSRC were deploying their iron, interest in ocean fertilization had rather taken a back seat in academic geoengineering literatures and policy discussions (e.g. Cullen & Boyd, 2008; Strong et al., 2009; Williamson et al., 2012). These tended instead to be preoccupied with discussions of sulphate aerosol injection (Hulme, 2012a; Izrael et al., 2009; Royal Society, 2009).

News of the experiment did nevertheless land on a loaded stage, coinciding with the UN Convention on Biological Diversity in Hyderabad (CBD, 2012) in which ETC Group and other non-governmental organisations were petitioning for the existing non-binding moratorium on geoengineering to be replaced by an enforceable test ban (ETC, 2012). More critical literature has suggested that the use of the term 'geoengineering' in relation to the project was therefore "useful for activists to link the project to solar radiation management and other contentious strategies"

(Buck, 2014b, see also Horton, 2012). The HSRC project then became quickly intertwined with framings and problem definitions of geoengineering documented in previous literatures on geoengineering media discourse[90].

Debates about the leverage that science and technology may offer humans to mediate the climate and ocean environments, the 'riskiness' and (ir)reversibility of ocean fertilization and the extent to which ocean fertilization may prop up existing economic structures (and the desirability of this) can all be identified within the discourse of the newspaper articles sampled in the study[91] (c.f. Porter & Hulme, 2013). Others accused the HSRC of "Playing God" (e.g. Hooper, 2013 c.f Fleming, 2007; Hamilton, 2011b), and of pursuing "a dangerous distraction, providing governments and industry with an excuse to avoid reducing fossil fuel emissions" (e.g Lukacs, 2012 c.f. Gardiner, 2011). The projects' supporters and defenders given voice in the corpus, can also be seen espousing 'political realism' (c.f. Buck, 2010) and 'climate emergency' framings (c.f. Buck, 2013a; Nerlich and Jaspal, 2012), asserting a desperate need to explore ocean fertilization as a 'Plan B' strategy (e.g. Doyle, 2013): "Despite the outcry and controversy, geo-engineering research will continue. Greenhouse gas emissions show no sign of slowing down, [HSRC Director Jason McNamee] said. The human population is on course to hit 10 billion by 2050, consumption patterns continue to grow and there is currently no realistic alternative to fossil fuels" (Moore, 2014b).

While these familiar frames and problem definitions can be recognised within the corpus of articles studied, the dominant framing of the project was 'set' early in the coverage of the HSRC experiment (Buck, 2013b). Indeed this was similarly observed by Participant Jack Larson "*it's like to me there's just one person cut and paste*" he explained. From the *Guardian's* first article on the project (Lukacs, 2012), journalists were almost invariably preoccupied with 'innovation' framings, through which the scientific validity of the experiment was debated, and 'governance' framings, concerning the (il)legality of the experiment, and questions of who should get to deploy geoengineering (c.f. Porter & Hulme, 2013: 345 & 348, see also Buck, 2014a).

"Geo-vigilante" (Hooper, 2013), "rogue geoengineer" (Lukacs, 2012), "music man-style charlatan" (Hooper, 2013) and "business man" (Hume, 2014), HSRC Director and former Chief Scientist Russ George was the central character in these narratives, cited in 58% of the articles obtained from the

[90] This observation offers a particularly visible example of the merits of an 'informed grounded theory' approach (see section 4.2.4.1). My prior engagement with this topic (see Porter & Hulme, 2013) inevitably sensitized me to these frames and therefore increased the risk that I would 'too easily find evidence for what I was looking for' and press articles into pre-existing frame categories (Hertog & McLeod, 2008). However employed reflexively, this previous experience provided opportunities to extend the inductive analysis, since without prior engagement with the research subject such insights into the ways in which the HSRC project was being framed in terms familiar to existing geoengineering media discourse would not have been possible.

[91] As detailed in section 4.2.2, a corpus of newspaper articles was compiled for analysis through a keyword search of English language news in the *Nexis* newspaper database.

Nexis newspaper database. As other prominent geoengineering voices such as Harvard's David Keith were drawn into the discourse, in much of the corpus the HSRC project became habitually branded 'unsanctioned', 'unproven' and possibly 'illegal' 'geoengineering', conducted by a 'rogue climate hacker' hoping to 'profit from global warming': Labels that even gained salience in geography literature (e.g. Yusoff, 2013).

Through this brief analysis of media discourse of the HSRC project, we see that in many ways narratives of the project in the news media were constructed using framings familiar to existing geoengineering media discourse. But in some interesting ways this coverage differed from that reported in previous analyses. Qualitatively a 'climate emergency' framing was markedly less prominent within the corpus than in previous analyses of geoengineering media discourse (Porter, 2011; Porter & Hulme, 2013). Articles also focused less on concerns about climate change and more on the absence of legal structures to prevent such "rogue" geoengineers.

Holly Buck has also noted the way in which reporting associated with this project pursued character driven, high entertainment and dramatic accounts (Buck, 2013b). Context was eliminated, especially when it didn't fit with the story being told, thus the frame stuck. Old Massett, the Haida community that financed the project, was meanwhile given little voice[92]. 33% of articles within the corpus referenced a Haida person or organisation, but the range of voices given expression were very limited[93]. Indeed when the community was discussed within the corpus of articles reviewed Old Massett tended to be characterized as a "tiny" (Biello, 2012), 'vulnerable' and now "misled" (ETC, 2013) First Nations band. After several months living alongside this community, and witnessing the on-going battle for autonomy and cultural revival in a post-colonial world, even as an outsider the paternalism of this depiction is insufferable.

5.5 The Old Massett Salmon Restoration Corporation

Despite the absence of Old Massett from newspaper reporting, as Buck (2014a) attests this project was done "by people in a place" and as will be argued during this chapter, for these people in this place there is little to suggest that the 'geoengineering' constructed in the news media had much salience for those who undertook the HSRC project. This affirms the importance of the primary analytic strategy of this chapter: To return some of the context to accounts of the HSRC project by developing a case description of the HSRC's ocean fertilization experiment and the motivations that brought this project into being. For a significant part of what remains of this chapter I am therefore going to explore the context in which the project unfolded. I hope to shed some light on

[92] As discussed in chapter 2, this is not atypical of geoengineering media coverage where a small group of atmospheric scientists have been argued to speak loudest on geoengineering, while citizens are given little voice (Buck, 2013a).

[93] 71% of these articles cited only a statement released by the Haida Nations' federal government Council of the Haida Nation (CHN, 2012a) and/or HSRC Director Ken Rea, Old Massett's Chief Councillor.

the question of what this 'geoengineering', as it was so described by international media outlets, might have meant to residents of Old Massett, who voted to finance the HSRC's ocean fertilization project. Before I begin this task a couple of further qualifications are important.

Firstly it is important to note that residents of Old Massett are far from united in their support for the HSRC project. A representative of OMVC estimated a turnout of around 40% of the voting age population[94], but only 66% of those that did cast a vote elected to finance the project. Since the vote the project has been deeply divisive and many in the community are very upset by the project. "*It has divided families*", Participant Jack Larson explained, while Participant Charlotte Elliott elaborated, "*it has split even families because there are some people who are related to Old Massett Village Council members and they want them to pull out of it and they're quite upset with them that they won't*".

In addition to the disunity in Old Massett it is important to note that the Haida Salmon Restoration Corporation cannot be understood as a 'Haida' project in any uncomplicated way. The project was financed by Old Massett Village Council which administers the affairs of the village of Old Massett: A Haida 'reserve' as designated in Canadian federal law by the amended 1867 Indian Act. OMVC performs the role of a village government and is accountable to its own membership – Old Massett band members – but it does not represent the wider Haida Nation. That instead is the responsibility of the Council of the Haida Nation (CHN), whose membership features Haida representatives from Skidegate, Vancouver and Prince Rupert, in addition to Old Massett. Understanding OMVC as a provincial government and CHN as the Haida federal government could help clarify this relationship[95].

CHN has publically distanced itself from the HSRC project (CHN, 2012a) and many Haida residents in Skidegate, who had no consultation or voting rights on the project, have widely expressed hurt and anger that they have been implicated in the project (e.g. Brown, 2013). Indeed longstanding tensions between the two communities have been reignited such that some OMVC representatives will no longer attend meetings in Skidegate.

For some Haida in both Skidegate and Old Massett the HSRC is seen to have dragged the Haida name "through the mud" (Brown, 2013) and, as will be discussed in section 5.6.1.1, for a nation with a proud "culture… born of respect; and intimacy with the land and sea and air" (CHN, 2010a), some feel the project has done "*a lot of damage to us in a promotional, visible brand way*" (Participant Kelly Baker).

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[94] "*The registry clerk in Old Massett tags the community population at about 740ish. Over 300 of these are below voting age. So of the balance of [less than] 440 we had 168 cast a vote. That's about a 40% turnout"* (Participant Raymond Wallace).
[95] Further complicating this distinction Participant Raymond Wallace argued that since up until the late 1970's "*Old Massett was and always had been simply known as 'Haida'... [So in fact] the name kinda fits well, right?".*

As Participant Brent Morton explains: "*Honestly the biggest problem with the Haida Salmon Restoration Corporation is they put Haida in the name. I mean if it was Old Massett Salmon Restoration Corporation, it would have been a completely different story… the Haida people have built their reputation up to, you know, where I would say we're one of the strongest nations on the coast… we've done so many precedent setting cases in Canadian law that to have this negative image on us, a lot of people weren't happy. Because our past leaders have built a road to where we're viewed in a really high regard with provincial and federal government. I mean I'm guessing they don't like us, because we're very persistent. So to have that image like smeared… I think that was our greatest problem*".

The extent to which the HSRC can be said to represent Old Massett will be returned to later (section 5.7.4). But since much of the significant on-island tension surrounding the HSRC project relates to its designation as an 'Old Massett' or a 'Haida' project writ large, clarifying this distinction early in this chapter has ethical importance.

5.6 What Motivated the Village of Old Massett to Finance the HSRC?

5.6.1 The Haida Relationship to the Land and Ocean

> "The Haida Nation is the rightful heir to Haida Gwaii. Our culture is born of respect; and intimacy with the land and sea and the air around us. Like the forests, the roots of our people are intertwined such that the greatest troubles cannot overcome us. We owe our existence to Haida Gwaii. The living generation accepts the responsibility to insure that our heritage is passed on to following generations. On these islands our ancestors lived and died and here too, we will make our homes until called away to join them in the great beyond"
>
> – Constitution of the Haida Nation (CHN, 2010a)
>
> *Box 5.3*

To situate Old Massett's engagement with the HSRC proposal, it is important to have an appreciation of the Haida relationship to the land taught in oral history. Indigenous peoples are highly varied, yet when denoting 1993 the 'International Year for the World's Indigenous People', the United Nations noted that a special relationship with their natural environment unites Indigenous peoples globally (UN, 1991).

For Haida people, Haida Gwaii is home in the practical, religious, political and cultural sense. 'K'aygang.nga' – Haida oral histories of long long ago – describe the Haida as originating from the land and ocean of Haida Gwaii (CHN, 2011) and this relationship with the natural world is at the heart of Haida culture and identity[96]. Former CHN president Guujaaw explained this through

[96] Different Haida clans have different accounts of their origins. Some trace their origins to Foam Woman who arose on a reef, while Bill Reid's sculpture 'the Raven and the first men' depicts several raven clans emerging from a clam shell (Jones & Williams-Davidson, 2000). CHN (2009a) recounts k'aygang.nga (Haida oral histories of long, long ago) where Haida people came to Haida Gwaii in three waves, from the air, earth and then the ocean.

reference to the infamous 1985 Haida blockade at Athlii Gwaay (Lyell Island) where Haida people, elders first, were arrested defending the area from further clear-cut logging. "We wanted to make it real clear that our culture is our relationship to the land", he said. "That's where our songs come from, that's where our language comes from, and the dances are all about the creatures that we share this land with. And so we brought the songs back to the land to express exactly who we are" (Guujaaw, cited in Gill, 2009: 128).

In Box 5.4 Participant Joanna Cook is revealing that for many the Haida relationship with the land is deeply spiritual and totalising, such that it is nearly impossible to tease out this relationship from artistic, spiritual, cultural and even political Haida ways of life. "Ginn 7waadluwaan gud7ahl Kwaagiidang - Everything depends on everything else" as the ancient Haida saying goes (Turner & Wilson, 2009: 130). Rich in the supernatural, Haida oral history affords animate and inanimate beings a spirit (Bringhurst, 1999; Swanton, 2010; Swanton & Enrico, 1995).

"*The main thing that I know about who the Haida people are, [is that] the very core of who we are, our spiritual strength, everything about us, comes from the land. Our strength comes from the land. Our wisdom comes from the land. And our relationships as well. And they are spiritual relationships*"

- Participant Joanna Cook

Box 5.4

"Haida beliefs about their origin and relationship to the natural world give an intrinsic value to the natural world and all its elements including fish, sea mammals, birds, land animals, creeks and places. In the Haida world view… humans have a spiritual connection and dependence on animals and the environment" Jones & Williams-Davidson (2000: 102) explain. Following previous literatures (e.g. Kawagley et al., 1998; Lin, 2011), Jones & Williams-Davidson (2000: 102) contrast these beliefs "with Western policy and law that is generally anthropocentric and assesses value in terms of uses by human society".

Through this account Jones & Williams-Davidson are reflecting an intimacy with the land and sea that pervades accounts of what it means to 'be Haida' and that lies even at the heart of the Constitution of the Haida Nation (CHN, 2010a, see Box 5.3). This reverence for the natural world does not prohibit the Haida from utilizing Haida Gwaii's natural abundance. Instead oral history links the land and the people through the belief that one cannot exist without the other (see Bial, 2001; Jones & Williams-Davidson, 2000; Suzuki, 2000).

To this day people in Haida Gwaii are heavily reliant on their natural resources and in traditional hunting and gathering the animal or tree harvested is thanked for its gift through song and prayer[97] (CHN, 2005). As Participant Jane Clarke explained, "*our way of life has worked for thousands of years… It's about food gathering and that's one of the reasons why in a small area you can have such high unemployment, because you've got food at your doorstep. Most places in this world don't have the quantity and quality of food to feed themselves from a natural source*". In Haida teaching, with this use comes "Laa guu ga kanhllns" (CHN, 2007: 4), responsibility to "protect the magic of Myth Time by treading lightly on the natural world, the plane that connects us to the spirit of our ancestors – to maintain balance on the edge of the Earth" (Artist SGaana Jaad April White in Suzuki & Davis, 2012: 82, see also CHN, 2010a)[98].

Participants accordingly shared stories of how Haida people have lived sustainably on Haida Gwaii since the beginning of time. As Participant Marlene Hawkins said for example, "*we are very special to be put here, so we needed to know and set some guidelines on how to conduct ourselves here… It was laws of guidelines set to say you never take any more than you need. And we did well [for] 10,000 plus, 14,000, 20,000 [years]. For us the beginning of time. We moved here and we built many totem poles and many longhouses and yet when white people first came here you couldn't tell. There was nothing destroyed*".

> "*Our people took such good care of this land and we have so many different stories about how we would only take what we need and we would make sure that it was going to be there for the next year, and the next year and the next year. We were very forward thinking in that way of rejuvenation of our stocks. We would never demolish or take too much. Greed must have been an issue, but it wasn't the biggest issue for our people, because everything was so plentiful. The standard of living must have been amazing. You can tell it in our art, when you go along the coast, that life must have been so easy for these people to spend all this time on totem poles and canoes and carving masks… So it's quite the reputation to uphold*"
>
> - Participant Brent Morton
>
> *Box 5.5*

Some, like Participant Brent Morton in Box 5.5 above, were more careful not to romanticise the Haida way of life. But all respondents emphasized teachings from Haida oral history which, until European contact, allowed Haida Gwaii to persist with environmentally rich, healthy, intact ecosystems that supported an abundant diversity of life[99]. The creators of some of the most

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[97] "*[It's important to] understand the reverence that we have for the wind and rain and the sea and the supernaturals. The powers in the forests and their domain. Like when we go in the woods we tell them, the bears, we are your sisters, we're just coming in for berries. We're not going to do anything. We will leave. Then the bears don't bother us… so we just let them know. We are just here for a short time. Thank you for letting us be in your place"* (Participant Joanna Cook).

[98] Participant Marlene Hawkins elaborated, "*We've been here three times… It doesn't say what happened the first two times. But I'm not thinking it's too unlike now. You know we didn't take care of things and if we don't take care of things it leaves us. When we don't respect things it leaves you… Every Haida… is charged with taking care of Haida Gwaii from the beginning of time. That's our responsibility to our ancestors that came out of the ocean… once you've been here you know, who wants to lose it? Not me*".

[99] There are countless records from European colonists which corroborate these accounts of almost unparalleled environmental richness at the time of contact. However as Jisgang Nika Collison spoke in her testimony to the Truth and Reconcilliation Commission, "before Europeans ventured our way, our Nation

admired canoes on the coast, the Haida were traditionally a seafaring nation and these teachings extend into the Haida relationship with the ocean and the marine environment. Such connections manifest extensively in Haida art and shape Haida environmental policy today (see for example an extract of the principles identified in CHN's marine use planning process in Box 5.6 below).

HAIDA ETHICS AND VALUES

Our way of life teaches respect for all life. We live between the undersea and sky worlds that we share with other creatures and supernatural beings. Our responsibilities to the sea and land are guided by ancestral values.

Yahguudang or Yakguudang *Respect*
Respect for each other and all living things is rooted in our culture. We take only what we need, we give thanks, and we acknowledge those who behave accordingly.

'Laa guu ga kanhllns *Responsibility*
We accept the responsibility passed on by our ancestors to manage and care for our sea and land. We will ensure that our heritage is passed onto future generations.

Giid tll'juus *The world is as sharp as the edge of a knife.*
Balance is needed in our interactions with the natural world. If we aren't careful in everything we do, we can easily reach a point of no return. Our practices and those of others must be sustainable.

Isda ad diigii isda *Giving and Receiving*
Giving and receiving is a respected practice in our culture, essential in our interactions with each other and the natural world. We continually give thanks to the natural world for the gifts that we receive.

Gina k'aadang.nga gii uu tl' k'anguudang *Seeking Wise Counsel*
Our elders teach us about traditional ways and how to work in harmony. Like the forests the roots of our people are intertwined. Together we consider new ideas and information in keeping with our culture, values and laws.

(CHN, 2007)

Box 5.6

5.6.1.1 The Haida Relationship with the Environment and the HSRC

As will be explored in chapters 6 and 7, for various reasons and for many people, the HSRC project was an assault against Haida teachings and values and the Haida relationship to the land taught in oral history was at the heart of many Haida people's fervent resistance to the project. When asked how she thought people in Haida Gwaii will tell the story of the project in the future, Participant Joanna Cook for example responded, "*[they will say] that the Supernaturals of the ocean found the Haida to*

already had archives. They were in the form of carefully preserved oral histories held in trust by our storytellers. Our audio-visual archives were, and are, our two dimensional formline, carvings, weavings, dance and other ceremony that visually represent our oral histories rights and privileges" (Collison, 2011). A great frustration of Haida people, and indeed of Indigenous people writ large (Howitt, 2001), is therefore the experience that their traditional ecological knowledge and oral history needs to in some way be validated or verified by outsiders to be considered true by the outside world. "*Now we need to bring in scientists to prove what we said*", Participant Joanna Cook explained. This work therefore aims to put data collected from Haida experience and oral history at the heart of the analysis, to avoid further 'deep colonizing' (Rose, 1999).

be so arrogant, the Haida in Massett, no, a handful of Haida, five or six Haida, to be so arrogant as to assume that they understood the dominion, the area of which the Supernaturals have authority. And they overstepped their rights by entering into their homeland and endangering and putting things off balance in the area that they keep in balance. So much so that they created the earthquake… and something so precious, so spiritual, so wonderful to us as hot springs, was shut off to us. I hope it's only for a time. But it's a handful of Haida. I believe there was arrogance. We can't be arrogant".

Conversely however others made sense of the HSRC projects' aims and activities through ideas of environmental stewardship, and for some the project was justified in the context of the deep spiritual and practical relationship to the land taught in Haida oral history. Participant Susan Hughes described for example how she feels ocean fertilization mimics traditional practices of 'giving back' to the ocean. "*That's just like how we believe here, that we're all interconnected, that whatever we do affects everybody and nature… Just say for instance, it's called offal in the canneries… where we're throwing the shells and the innards, whatever we're working on into the waters. But that's not polluting to us. When we have something we put it into the ocean. That's nourishing the ocean. But they've [the government] told us to stop doing something we've always done. It's like the salmon, there are stories about how we returned the bones to the ocean and if we leave a part out then the spirit life will suffer because it's missing a part of it. We've always had ways of fertilizing… we fertilize what we have here. To most of us it wasn't wrong. To some it was wrong. But to most of us it wasn't, because that's just what we've always done. We observe even animals do it. The bear takes the fish into the forest and it's fertilizing the trees*".

Another described ocean fertilization in terms of the Haida traditional system of environmental management obligations, wherein different clans, villages or families have responsibility to maintain and care for different areas of Haida Gwaii. "*To me it's the same as, like all these rivers here in these inlets, certain villages or certain families have stewardship of these places… All of us in Massett here all come from all the outlying villages that once existed 200 years ago. So that area is technically our area to have stewardship over… And that's part of what you need to do, to steward it… That's part of the management and the 'putting it back' [teaching]"* (Participant Rudy Cooper). As will be discussed further in section 5.7.4.1 below, the HSRC and HSRC representatives drew on this connection extensively in their accounts of the project (see Box 5.7).

"As the people of Old Massett who have long sought to live in harmony with land and sea a simple truth has become apparent. We must rekindle our stewardship of our ocean pastures; it is a cultural, spiritual, and practical imperative. The Haida people and culture would never have flourished as it has for millennia without the relationship we have with the salmon and the sea. Modern science is helping show us the path we must take"

– HSRC, 2013b.

We are stewards of the land [and take] strong leadership positions when it's coming to resource management and sustainable development. This is nothing new and we've been here for generations and we want to ensure we have a healthy ocean for future generations"

- Old Massett Chief Councillor Ken Rea at the 2012 HSRC Vancouver Aquarium press conference (Smith, 2012).

"*We live off the land and the oceans here, that's what we do, we're connected here. So if you come at it from that perspective and I go down this path of opening this all up and you have the knowledge and the information and the understanding to realise there's this huge problem facing us and now you put together a possible solution, if you did nothing that would be kind of negligent wouldn't it?*"

- Participant Raymond Wallace

Box 5.7

5.6.2 Carbon Credits in Exchange for Environmental Protection

Another way in which the HSRC project gained support was through the potential for Old Massett to seemingly protect their treasured local environment, in exchange for carbon credits. Whilst still possessing outstanding diversity and resource richness, present day Haida Gwaii is environmentally impoverished compared to it's pre-contact state. Since colonization, Haida Gwaii has seen its resource base deplete, as billions of dollars of natural resources have been shipped off-island, largely unchecked, by extractive industries (primarily logging and fishing). As the Haida Land Use Vision surmised, "there has been no comprehensive planning or regulation other than the extraction of resources and revenues to feed the insatiable appetite of people who don't live here and [who] are not concerned with the consequences of their actions" (CHN, 2005: 5).

Driven by the need for employment, many Haida people have participated in these industries, causing tension within communities. "*When we go to our public meetings half the people say quit logging, the other half say we need jobs, because we've not been working for so long. So what do you do?"*, Participant Noel Townsend asked. However owing to exclusions, regulations and institutional barriers, Haida people have primarily only profited from these industries as labourers (firstnations.de, 2014) and through this over-exploitation much has been lost. Monumental cedar are disappearing at such a rate that threatens the future supply of suitable trees for poles, canoes and longhouses and many traditional foods, including those used for ceremonial purposes, are increasingly difficult to come by. "*200 short years after they [Europeans] got here there's hardly any old growth forest. There's no more herring. There's no more albalone. Despite our protesting and telling the government this is wrong… We don't have [oolican] anymore. Probably never will"*, Participant Marlene Hawkins reflected. In what seemed to many to be a final

insult, during the 1990s the Haida also lost their sacred Golden Spruce 'Kiidk'yaas' to a protest act against the logging industry (Vaillant, 2005).

In a place where extraction is the norm, and where the environment continues to be threatened through such initiatives as the Enbridge pipeline proposal, is it easy to understand why carbon credit schemes that result in payment to ostensibly protect the treasured environment and resources could appear attractive to Old Massett. Furthermore First Nations bands across Canada, indeed Indigenous groups globally, are widely engaging with carbon credits as a way to generate income for communities. Thus when the HSRC was proposed to Old Massett, the Haida already had experience of pursuing particularly forestry-based carbon credit opportunities (see coastalfirstnations.ca, 2014). Indeed Russ George himself had been a key actor in this arena conducting, for example a "riparian climate forest feasibility study and pilot project" which aimed to target "underperforming rainforest lands" primarily in riparian reserve zones on Haida Gwaii (George & Buchanan, 2004/5: 7).

5.6.3 Concern About Salmon Populations

> "Come to our school of ocean pasture stewardship and we will teach you. There is much to learn and we will show you that the learning[,] so that your village can achieve immediate results[,] comes easy. We've done most of the hard learning and will make it easy for your village. You just need to begin".
>
> - A call to 100 villages. You can bring back your fish. (George, 2013b)

Box 5.8

Salmon restoration was key to the projects' framing and there are many good reasons why 'salmon restoration' would interest Old Massett. British Columbia has been experiencing declines in a wide range of fisheries and Haida Gwaii is no exception (CHN, 2014a; 2007, 2005). The reasons for declining stocks are numerous and complex, but are thought to include pressures from over-fishing, climate change and pollution (CHN, 2014a; Cohen, 2012b). In Haida Gwaii salmon stocks, and sockeye salmon in particular, are considered to be in "dire straits compared to their historical abundance" (CHN, 2005: 10, see also Cohen, 2012a). Extensive logging in riparian areas, which has degraded salmon breeding and rearing habitat, is held as a major factor contributing to this decline.

The Haida Nation has long expressed commitment to restoring and protecting the marine ecosystem in line with Haida ethics and values (CHN, 2014a; 2007)[100]. Commercial logging accordingly now faces new restrictions to protect riparian areas (CHN & BC, 2007: 19) and some

[100] See for example the CHN Haida Gwaii Draft Marine Plan which seeks to put a range of Haida ethics and values – respect, balance, interconnectedness, giving and receiving, responsibility, seeking wise council – at the heart of marine planning and restoring the impoverished marine ecosystem (CHN, 2014a; 2007)

work has been done to restore these habitats (CHN, 2014a). But logging of riparian areas on private lands remains an issue (SEHAB, 2009) and local ecologists comment that there is "*much more to be done*" (e.g. Participant Valerie Collins)[101]. Old Massett has been running a salmon hatchery on the Yakoun River for forty years but as a result Participant Jack Larson reported, "*we are getting desperate because our fish is disappearing, so we need to try something*". When told by the HSRC the problem was at sea (see Box 5.9) Old Massett was surely ready to listen.

"*We know what salmon we're sending out. We have those records, those are firm. So we have those from the river. We're sending out good groups, schools of salmon. But they aren't coming back. We start connecting those dots and saying, okay well what is going on offshore… And then you very soon find out that the reason they go offshore is because of the plankton biomas out there. That's their grazing ground as it were. So they go off and in the case of spring salmon it wouldn't be so much the phytoplankton that they would be heading offshore for, they would probably be heading for the zooplankton which feed on the phytoplankton, they are both very connected… So what was happening we figured right off the bat was that the juvenile salmon were arriving on the feeding grounds… offshore and if there wasn't the plankton biomass there for them then the predators instead of feeding on krill and all the zooplankton and things, they, well hey, 'we'll just eat the salmon'. And so the salmon were getting heavily impacted*"

- Participant Raymond Wallace

Box 5.9

Old Massett's economy used to be heavily reliant on fishing and fish processing activities. But today there are few Haida boats on the water and the canneries open just a few days a year, rather than for months at a time. "*You look at the fishermen now they are all like 70 years old. There's not one fishermen in their 50s or 40s or even 30s. They are all 70. 60 to 70 years old, every one of them. Because there's no more fish right*", Participant Jack Larson attested.

But it is not just depleted stocks keeping the Old Massett Haida off the water. Access for islanders is limited by a complex system of fishing permits and competition with large commercial enterprises and sports fishing lodges. "*We've been legislated out of fisheries*", Participant Noel Townsend explains[102]. For some this is tied to "*a long history about how the Government of Canada wanted to get rid of the Natives… They turned around and offered those fishing licenses to other people. So we were forced out of the industry, even though it is our waters and we lived on it… And through their license schemes and everything else they made all kinds of restrictions that needed costly renovations… to meet the license requirements*" (Participant Marco Richardson).

[101] One of the worst examples of riparian logging degrading salmon habitat and spawning pools can be seen in the Ain River. Once the site of a major run, today it is barren of sockeye: "Creek woman's wealth has been diminished" CHN (2005: 10) explains.

[102] "*We've got so many requirements now to be able to run boats that we can't do things the way we've [always done*]", Participant Joanna Cook explained. While Participant Joseph Willis elaborated, "*you see the government walked in here and just gave it [fishing permits] to them [commercial sports-fighing lodges]… completely deleting us from any chance to make a living on our resources".*

These ongoing access issues challenge the idea that Old Massett stood to benefit economically from increased salmon runs. But fundamental to understanding Old Massett's interest in the HSRC's project, is appreciating the spiritual and nutritional value of healthy local salmon runs in the context of the "timeless and intimate" (CHN, 2011: 4) connection to the land and ocean.

Fundamental to the Haida connection to the land are the traditional foods which CHN (2011: 4) explains "are vital to the wellbeing of our people and communities. Many of them are medicinal, and they nourish and sustain us today as ever". Seasonal food gathering, and salmon fishing, which the Land Use Agreement describes as the most important source of nourishment in the Haida diet (CHN & BC, 2007), is deeply cultural; a way of life more than a perfunctory response to the islands prohibitive food prices. "You have to do these activities to be Haida. You have to do them to be part of the land" Haida retired marine biologist and weaver Dolly Garza explained in Bear (2010), highlighting that traditional foods are intimately tied to Haida cultural identity (Box 5.10).

"*It's our food and that's us. That's part of us"*

- Participant Susan Hughes

"*If the fish are gone I guess there's not much left of us… I don't think we could survive without our fish"*

- Participant Ronnie Stevenson

"*We are salmon people"*

- Participant Jane Clarke

Box 5.10

The significance of salmon as the "*life blood*" (Participant Jane Clarke) of Haida people has been extensively expressed through Haida art and is age-old (Bear & Jones, 2003, 2001). Indeed the relationship was quickly identified by European colonists, as reflected in the 150 year-old remarks of Naturalist John Keast Lord: "*Salmon is of the most vital importance to the Indians: deprived or by any means cut off from obtaining it, starve to death they must; and were we at war with the Redskins, we need only cut them off from their salmon fisheries to have them completely at our mercy*" (Keast Lord, 1866[103]).

Keast Lord's observation is poignant to the finding that depleted salmon stocks and structural exclusion from remaining fisheries is, for many, unambiguously neocolonial, and intimately intertwined with ongoing suppression of Native Title. For Haida people protecting and securing access to salmon is therefore fundamental to reclamation of the Haida cultural identity and autonomy after deliberate and systematic colonial violation of the Haida way of life (see section 5.6.6.1). With the loss of access to fisheries "*a sense of self-sufficiency disappeared from us*" explained Participant Joseph Willis. "*We just want to be out on the ocean*" (Participant Ronnie Stevenson). Any

[103] Sincere thanks to SGaana Jaad April White for identifying the salience of this quote.

project promising to restore local salmon runs was therefore always going to attract Old Massett's attention.

5.6.4 Concern About Anthropogenic Climate Change

Haida Gwaii already experiences fairly colourful coastal climate conditions, such as powerful storm surges and wave action, large tidal ranges, coastal erosion (CIP&NIC, 2008) and frequent, strong winds exceeding gale force (Walker & Barrie, 2006). Indeed with no area of land in Haida Gwaii being more than 20 km from the sea (Lee, 2012), Haida Gwaii, has been described as having one of Canada's most "sensitive" coasts (Walker & Barrie, 2006: 220). The Northeast of Graham Island, encompassing the communities of Old Massett and Masset, is particularly low-lying and at times evacuation routes for these settlements, in this seismically active area, have been closed off due to inundation and washouts. In 2015 the area has also experienced an extended period of drought, inducing water shortages and the threat of forest fires.

In the face of these challenges people in Haida Gwaii have shown enormous resilience (Observer, 2007), yet evidently the islands experience some clear vulnerabilities in the face of anthropogenic climate change. That the world's low-lying coastal communities may experience such impacts as loss of land, settlements, infrastructure, cultural sights and ecosystems from coastal erosion and sea level rise has been well documented (Cinner et al., 2012; Dolan & Walker, 2006; IPCC, 2014b). So too have the risks of coastal flooding, saline intrusion in agricultural land and aquifers and livelihood losses. Many of these physical trends are anticipated in Haida Gwaii and on the wider Northern BC Coast (Kershner, 2010; Okey et al., 2012; Walker & Barrie, 2006), along with for example temperature increases, increases in the frequency of extreme weather events, changes in runoff and snowpack and ocean acidification (Okey et al., 2012).

In multiple forums the Haida Nation has recognised climate change as a significant threat to Haida Gwaii. CHN's marine use planning process for example listed climate change as one of two key pressures and uncertainties with the capacity to significantly impact Haida Gwaii and its marine ecosystems (CHN, 2012b; 2007). Further in local policy making arenas, former President of the Haida Nation Guujaaw proposed that First Nations leaders in the Pacific Northwest might sign the Kyoto Accord unilaterally, given that they are not yet recognized as Nation states and thus are not members of the United Nations (Gill, 2009).

Despite literature which suggests that people find climate change, "the scientific phenomenon" (Jasanoff, 2010: 237), to be abstract and hard to relate to their daily lives, ideas of anthropogenic climate change appeared to be prevalent in many participants' engagement with their environment.

In this way 'climate change' appeared to function as a discursive frame, through which participants made sense of perceived changes (c.f. de Wit, 2011[104]).

As described in section 4.2.3.2.1, given local sensitivities surrounding the HSRC project, for ethical reasons it was important to alert participants to my research interest in the project, rather than recruit topic-blind. Given that participants were often familiar with the HSRC's stated goals pertaining to developing a meaningful response to the threat of anthropogenic climate change, it is possible that this framing of my research could have influenced participants' responses. Nevertheless participants regularly reported changes they have observed in their environment and related these to global concerns about anthropogenic climate change: "*I mean global weather conditions are changing. There's absolutely no question. Any sane person I think can see that. I mean we'll be able to go through the Northwest Passage in the winter pretty quick which is just an absolute – And that's just happened in the last, you know, basically hundred years, that we've done more changes to the climatic conditions, probably in the last fifty years, than in the previous five thousand years*" Participant Harry Doyle attested.

As shown in Box 5.11 below, many people in Haida Gwaii described, for example, how they have observed their environment and their activities to have altered in response to climatic changes – the timing of food gathering activities, weather patterns and the behavior of other species were among the examples. Further reflecting findings of previous research on perceptions of climate change (e.g. Spence et al., 2011), by relating local experiences of weather and climate phenomena to ideas of global anthropogenic climate change, they expressed concerns for their livelihoods, for their community and for future generations. As Buck (2014b) observes, through the HSRC project "village science meets global discourse".

[104] Jasanoff (2010) also cites examples of cases where people have sought to reintegrate global knowing with local meaning and thus reposess the global at a local level.

"*It used to be cold. [There] used to be lots of snow. We don't see that any more. [The] weather is warmed up. Not to the extent what scientists claim. But it definitely is warmed up and the water is rising, there's no two ways about that. And that's the climate change that's developing that. Down at the cemetery here, at the North-end of the Island, beyond the village, where the whole erosion of the shoreline, that's climate change. So the whole issue of our water, salt water in particular, is definitely rising. Through my life I've seen a big change in the water… But you're not there continually to watch it. It's just a daily, year after year occurrence that we visualize. So it's a very hard thing to really analyze. I could be a liar for all I know. But through my life I've seen these changes*"

- Participant Joseph Willis

"*Like right now we have had such a dry summer… If you look at the salmon, they were sitting out forever out in that water, and when they get into the water, because it was so low they couldn't come, and too warm… They are all worried that they are not going to get the spawn that they need. So the climate change is affecting us… I think the Gaia effect says that we are past the point of no return… the earth is now giving in. It's allowing – And you can see species moving North already*"

- Participant Joanna Cook

"*We got involved in a pilot project to see if we could grow scallops here… This guy in Nanaimo… he supplies scallops to Japan and he lost his whole thing because of ocean acidification. Then the next year he had a hundred million seed or something and he ended up with 6 million left or something… This is worrying stuff. So we're looking at, we're still looking at aquaculture, like starting an industry on island now. But we're having to build in those considerations into that project*"

- Participant Raymond Wallace

"*Obviously climate change is having an impact on weather, I mean we see it up here. I mean our weather patterns are becoming more unpredictable all the time*"

- Participant Lewis Fletcher

"*Of course there is the question of how much is the sea level rise going to be. There's talk about, well, it's not just the melting of the ice on the caps in Greenland, it is also the fact that as the water heats up it expands, so that's going to, so you have these huge numbers of us living on Haida Gwaii fairly close to the ocean in all the communities… [That would] have huge consequences for us on the islands here*"

- Participant Ashley Turner

Box 5.11

In multiple ways Box 5.11 shows respondents "dwelling with the weather" (c.f. Vannini et al., 2011: 368). To echo the language of Vannini et al., people in Haida Gwaii are "weathering" reflexively, perceiving what the weather and the changing climate is doing to them, to others around them and to the world in which they live. They are making sense of the present climate by comparing it to the past, and making meaning through engagements with others. This "dwelling" links weather and climate with the close spiritual and practical relationships to the land that many residents of Haida Gwaii describe, as well as with vibrant and environmentally connected local identities. Thus we see, as Matthewman (2000: 209) suggested, in Haida Gwaii "weather at once speaks to notions of identity, community, locality, 'race,' and nationality" (see also Ingold, 2005).

In Box 5.12 below Participant Kelly Baker is passionately articulating her experience of "dwelling" with the climate. This speech emerged from a lengthy discussion about climate change and ideas of

geoengineering. Participant Kelly Baker feared that changes in the climate, whether through anthropogenic climate change, or brought about through geoengineering, will impede her ability to dwell with her climate in a personally meaningful way. Discussion below will thus link perceptions of climate change among some participants with identity and ambitions for self-determination.

"*I live in a place like the Pacific Northwest where our seasons aren't quite as you know, as cut and dried as back East… But we've had a very warm, a very very hot summer. We haven't seen this kind of summer in well over 10 years… You know I love sunny days and I love summer stuff. But you know, I like it cooler. I don't like being too too warm. But I enjoy the freedom of the beautiful soft summers we have and how light it stays out. Because we are pretty close to Alaska. It doesn't stay light out 24 hours like they get, but you know, some of our evenings, at the height of the season, can go into 10.30, 11pm. You know and so it's a really magical time. But I often just start craving Fall. It's just it's something natural. I think it's the right of passage. It's the way you mark different events in your life. So it's an internal circadian rhythm more than just the sun rising and the sun falls. Sunset, you know its about getting enough sleep. It's about certain things coming at certain times of the year.*

You know I could get all Indigenous about you know fish coming in at certain times and fish going out and certain seasons for certain foods, which is totally, totally important. And it's really, it's very cultural, which is very important to me. But it even goes more to an atom level. I think you cannot function [without these seasons]… There's something very resting and regenerative [about winter]. It gets pretty dark here too so on the reverse of having these really early mornings and really late evenings, we actually have really late mornings and really early evenings in the winter and it's really dark and some years we get sick of it and you just can't wait until the sun comes up. But some days, some years, when you've had a really busy summer, to me there's something regenerative about it. It tells you it's time to rest. It's time to sit and store yourself. Do things, take care of yourself. Be with family.

I think all those things, we can get – I can get fancy about it, but all those things are instinctual internal drives I believe. We are a creature, we are a species and we need to respond to things. And like any species, whether it's the bear, or whether it's anything, all of these weather and climate indicators, they are signals for us to start doing certain behaviours. I think if we change that, we are radically changing our fundamental core… I can totally wax and go on about being an Indigenous woman, looking at that, and considering that. But for me it's even more fundamental than being Indigenous and what an Indigenous person or Haida person, and I'm profoundly Haida. I'm so deeply Haida. Like I can go into it, but I think it's even deeper than that"

- Participant Kelly Baker

Box 5.12

As ideas of anthropogenic climate change have penetrated local engagements with climate and weather, so too has interest in mitigation. Participants for example were often conscious of the relatively high per capita greenhouse gas emissions on island, owing for example to their relative geographic isolation, the Islands' North grid being powered by diesel generators, the prevalence of wood-burning stoves and widespread use of large trucks on island. "*We're the worst polluters on the island"*, Participant Joseph Willis suggested, while Participant Brent Morton elaborated "*it's a grim thought but as far as I see it, we're basically on a one way track to being doomed. Everyone is just so content with their lives right now that they don't even – You know like myself. You know I pollute. I drive a van. I go on airplanes. I do it all*".

This frustration with Haida Gwaii's own contribution to rising greenhouse gas emissions was coupled with respondents reporting widespread alarm at the lack of meaningful action to address emissions globally (see Box 5.13 below). National climate policy including development of oil exploration and extraction in the Alberta tar sands - which Participant Valerie Collins described as the "*biggest debate in Canada now*" – positioned Canada itself as generally the greatest villain in these storylines.

"[Canada has] gone from having this pristine reputation as being the good guys in a United Nations meeting, to be really clearly one of the worst guys" Pat Mooney from ETC Group argued at a meeting held in Masset in March following the HSRC experiment (Marine Matters, 2013). This sentiment was also echoed by respondents who, in addition the tar sands, drew upon international climate policy, including Canada's absence from the Kyoto accord, to argue that the national Canadian government is failing to take climate change, and the interests of it's citizens seriously[105].

"*That summit or whatever it was, what was it called that was held in Rio de Janeiro. Many reasonable people said if we all cut down using fossil fuels, if we cut down this, if we all changed our cars to have emission controls you would reduce it greatly in 20 years. That seems long, but if we all did it you know. But Canada won't even adopt those. Because they are so greedy for money*"

- Participant Marlene Hawkins

"*The height of the ice melt every year is basically the Fall equinox. So last year, on September 21st, we were losing the Arctic ice at a hundred thousand square kilometres a day. Does that number strike any worry in your heart? A hundred thousand square kilometres a day. That's an enormous worry to me*"

- Participant Raymond Wallace

"*At what point are we going to listen, are governments going to listen? Are they going to let us all die?*"

- Participant Susan Hughes

"*I think we have to do something, because if this keeps up for even another 10 years, we are in serious trouble*"

- Participant Joseph Willis

Box 5.13

In this section we can see how concerns about climate change among participants have salience with 'climate emergency' and 'political realism' framings, typical of previous studies of geoengineering discourse (e.g. Anshelm & Hansson, 2014; Nerlich & Jaspal, 2012). As discussed in section 5.2 these narratives were also at the heart of media framing of the project. Thus while far from unanimous, some felt the HSRC project was an opportunity for Old Massett and affiliates of

[105] Related debates about Prime Minister Stephen Harper silencing government scientists (Chung, 2013) and about higher than normal incidence of cancers being documented in First Nations communities downstream of the tar sands (Alberta Health Services, 2009) were drawn into these narratives. So too were rumoured linkages between fracking and earthquakes (CBC, 2012).

the HSRC, scared about the potential consequences of anthropogenic climate change and feeling disempowered to bring about change at the national level, to take this matter into their own hands and to take steps towards finding a solution to climate change. Such rationales also lead some participants to express a wider interest in exploration of other geoengineering proposals (Box 5.14).

"*It [geoengineering] is an attempt to try and solve some of these problems… we gotta do something or we're all going to sink*"

- Participant Susan Hughes

"*The way things are right now, if we don't do something, it's just going to keep getting worse. Because they are not going to stop producing oil and gas. They are not going to stop burning coal, not until there's none left… so we have to do something and [geoengineering] I see as having potential*"

- Participant Rudy Cooper

"What I'm thinking, [is] that this is what might actually solve, or at least [offer] a band aid solution… Because right now my biggest worry is we're running out of good food to eat and drinking water. And I look into my kids eyes all the time and wonder geez what are we doing, are we going to cause a big war for you. That's my biggest fear right."

- Participant Jack Larson

Box 5.14

Understood in this way the HSRC project became just that symptom of failed global climate governance that has characterized many newspaper portrayals of potential "rogue" geoengineers to date (Porter, 2011)[106]. An attendant at the public meeting ETC Group's Pat Mooney held in Masset perhaps asked the most poignant question on this matter: "My concern is that Canada is one of the few countries that has totally ignored if not totally booted out the Kyoto Accord… Is it any wonder that those of us on the local levels are willing to do something to at least take a stab at it?" (Marine Matters, 2013).

5.6.5 Poverty

When news outlets (e.g. CBC, 2013) characterized Old Massett as an "impoverished village" on the quest for carbon credits, many local residents were frustrated by this reductive characterization of their wealth. "*We get dubbed as a poor community, but I've never felt poor in my life. Even though my bank account would probably say different. I've never gone hungry. We eat the best food in the world and we hang out with some of the best people in the world. We're quite content*", Participant Brent Morton explained. Yet despite such heartening sentiments, depictions of poverty find salience with many conventional

[106] "If climate change turns ugly, then many countries will start looking at desperate measures… Geoengineering may not require any collective international effort to have an impact on climate… A lone Greenfinger, self-appointed protector of the planet and working with a small fraction of the Gates[']bank account, could force a lot of geoengineering on his own. Bond films of the future might [enjoy incorporating] the dilemma of unilateral planetary engineering" (David Victor cited in Adam, 2009).

development metrics. As Ian Gill (2009: 53) wrote, in Haida Gwaii "most pay cheques are hard to come by – earned in harsh weather, in dangerous jobs like fishing and logging".

As resources have depleted and many of the jobs associated with the remaining extractive industries have been moved off-island (e.g. the fish processing canneries), populations in Haida Gwaii have declined steadily[107]. This out migration has affected house prices, among other things, to an extent that many homes can't be sold and some are even abandoned. Businesses are suffering similarly. As Participant Charlotte Elliott explains: "*People have cut their inventory and their staff. Some of them have just completely closed up*".

A high cost of living, owing to the expense of transporting goods to the relatively isolated archipelago and to the need for islanders to commute to the mainland for more specialist (e.g. medical) services, exacerbates these challenges. As do the recent BC Ferries service cuts and fare increases, which described as "highway robbery" (GlobalBC, 2014), have lead some residents to accuse provider BC Ferries of "shutting down the north" (King, 2013a) (see Figure 5.2). Alcohol and more recently hard drug abuse have proved a further strain on communities[108].

Figure 5.2: BC Ferry and Marine Worker's Union's (2014) "Welcome Aboard Coastal Desperation" Facebook Timeline Photo

[107] Census figures released in 2012 revealed that between 2006 and 2011 Haida Gwaii saw a 9% decrease in its population. Old Massett's experience of this decline was more pronounced. Its population reduced 11.5% during this time, taking the total number of residents from 694 people to 614 (Observer, 2012a).
[108] A 2008 report by Northern Health found the highest levels of hospitalization for conditions related to alcohol abuse *and* to drug abuse in Northern British Columbia to be jointly experienced by Haida Gwaii and Fort Nelson (Northern Health, 2010).

Of all the communities on Haida Gwaii Old Massett arguably experiences these challenges most profoundly. Despite annual allowable cuts shrinking (BCABIC, 2014), on-island logging continues to generate millions of dollars in revenues (HaiCo, 2014), yet this provides little income for Old Massett. "*Old Massett wouldn't even notice if this shut down… It doesn't do anything for us*" Participant Jim Ross attested. Instead, as discussed in section 5.6.3, since European colonization the Old Massett economy has been primarily dependent on fish that it can now only get very limited access to. To this community which experiences 70% unemployment (Disney, 2012) and where much of the employment that is available is seasonal, 'salmon restoration' inevitably looks financially as well as culturally attractive (Box 5.15).

> *"One of the main reasons that I liked the whole idea of the salmon restoration corporation, was because… if it worked out the way it should, there will be an abundance of fish which will create employment for [our family] and a lot of other people in our village. With the canneries combined there was 250 people working all the time when they were operating*"
>
> - Participant Rudy Cooper
>
> *Box 5.15*

As symbolized through the "resource-curse" hypothesis (Auty, 1993), there is poignant injustice to poverty in Old Massett, which appears to motivate even off-island members of the HSRC: *"[It's as if] Haida Gwaii is a third world country… Yet, billions of dollars of logs have come off of those islands. Billions of dollars of seafood have come off of those islands. Billions of dollars worth of mining have come off of those islands and then they have left nothing. There's no hockey rinks. We are in Canada and there's not a damn hockey rink… So what drives me here is, in this case, is I guess the human angle. I mean they should have facilities there. They should have jobs there"* (Participant Rob Peters).

In these circumstances it takes little to imagine how 29 million dollars in carbon credits would look similarly attractive[109]. "*I think [OMVC] is desperate… [they] feel the poverty is real and the trauma is real. That's the residential schools… People lose people to suicide… [they] saw this as a way of making money for [their] people"* Participant Valerie Collins hypothesised. Participant Jim Ross offered some validity to this theory, testifying, "*you're not afraid to try something when you've got nothing to lose"*. Indeed evidence suggests that these factors were key to the way in which the project was pitched to the village. "*Every meeting [about the HSRC] was identical. It talked about the same thing. It was 'everybody's letting the people down... nobody's going to look after you. This is the only thing that is going to save you guys from unemployment and everything'… Nobody is helping us here… just because [we] are so remote, doesn't mean [we] don't matter"* (Participant Charlotte Elliott).

[109] This is the amount that Economic Development Officer John Disney is alleged to have promised Old Massett the HSRC would generate within two years (White, 2011).

5.6.6 The Quest for Autonomy

> *"Country it was taken. Land our God. Families were broken. Spirits were crushed. The language that was silenced, still free to be passed. The cup that was empty is slowly filling up. So we can pull together, show our children in this time. You see 'cause this is our homeland, these are our rights"*
>
> - 'Land Rights', Xavier Rudd

So far I have discussed how for some the HSRC project may have related to local ambitions for environmental protection, salmon restoration, a meaningful response to the threat of anthropogenic climate change and to the need for an on-island economic engine. Yet fundamental too is appreciating how ongoing struggles for Haida title, autonomy, and even national sovereignty, shape these goals and may have influenced the projects reception in Old Massett. If we are to truly "follow the plot" (c.f. Marcus, 1995) of the HSRC project, and if I, as the narrator, am to reflect and respect the local context in which this project unfolded, we must look first at the colonial history of Haida Gwaii that disempowered Haida people from access to resources and their cultural heritage.

5.6.6.1 Before Contact, Contact and Assimilation

Before English sea captain George Dixon arrived on the coast of Haida Gwaii in 1787 and pronounced the archipelago '*The Queen Charlotte Islands',* lowest estimates suggest that over 10,000 Haida people lived in over 100 villages located throughout the islands. Others estimates suggest this number to be many magnitudes more (CHN, 2013; Gill, 2009; Lee, 2012). Skilled artists with a vibrant culture permissible through environmental abundance, the Haida were also a seafaring nation. Through their enormous canoes, each carved out of a single monumental cedar, they had advanced trade links with other First Nations and were renowned warriors. Society was matrilineal, with advanced political and marital systems organised through a sophisticated clan system (see Collison, 2011).

While relations with European traders were initially fairly amicable (Harris, 1992[1966]), Europeans colonized Haida Gwaii alongside the rest of North America with devastating effects on the Native population. In what former CHN president Guujaaw has described as "germ warfare"[110] (Gill, 2009: 26), during the 1800s the Haida are estimated to have lost around 95% of their population to European disease epidemics, most notably smallpox (Lee, 2012 and CHN 2009b). By the late 1800s

[110] While this story tends to be told as one of unfortunate and unforeseen circumstance, some evidence indicates that this introduction of disease was intentional, even an early form of biological warfare. Accounts suggest that the Haida were given gifts of blankets and handkerchiefs from smallpox infirmaries, distributed as symbols and signs of friendship. In a letter of Lord Jeffery Amherst, Commander of the British Forces in the Ohio Valley in 1763 to his subordinate Henry Bouquet, Amherst spoke of his hopes that this strategy would result in "the expatriation of this execrable race" as a response to the "Indians" "unruliness" (CHN, 2009b). The story continues that the Haida that fell sick with this disease were told to hide from the disease among their healthy relatives, despite quarantine principles being understood at the time (CHN, 2009b).

there were fewer than 600 survivors (CHN, 2009b). Population losses induced an accompanying loss of knowledge, social structure, culture and tradition. These impacts were heightened by the oral nature of Haida culture. Kii'ijuus Barb Wilson, writing in *Haida Laas,* the journal of the Haida Nation, likened smallpox running through the Haida to "a fire burning a library of 30,000 books" (CHN, 2009b: 8). "When you think of the knowledge that was contained in 30,000 people and then we were decimated to less than 600, the fact that we can still function as a people is truly amazing", she continued.

To survive this devastation, in the early 1900s the remaining Haida congregated in two villages. Today the majority of people in Haida Gwaii of Haida ancestry still live in these settlements named 'Old Massett' and 'Skidegate', which were designated reserves under the 1876 Indian Act. One of the many effects of this relocation Lee (2012: 6) suggests was that "the vast archipelago and its natural resources previously managed by Haidas in a sophisticated system of family clan ownership and governance was more easily accessible to industrial developments and resource extraction by the settlers".

Despite the Haida Nation never ceding rights, title, ownership, or jurisdiction over Haida Gwaii, the Indian Act made Haida people wards of the newly formed Colony of British Columbia. Indigenous people became marginalized by nearly every measure of social and economic inclusion, and colonial powers augmented their already concerted effort at assimilating the 'Indians', and replacing Haida traditions and beliefs with Western ideals. "Being silenced held us in recession. It was almost like we were imprisoned. We couldn't express ourselves through our ceremony, through the knowledge that was handed down for generations", artist Robert Davidson explained (Globe and Mail, 2014: 5).

A key target of this endeavour was the 1884 Potlatch Ban. A ceremonial gift-giving feast, the Haida potlatch complements the customarily oral nature of Haida culture, allowing everyone invited chance to witness major changes in society, and obligating them to share the business of the potlatch with others (Halpin, 1984)[111]. Illegal until 1951 this ban effectively demolished the Haida governance structure.

Canadian sanctioned cultural oppression was also found in the residential school system, administered by Christian churches until the late 20th century. While experiences of these schools varied, children were separated from their families, many facilities were associated with physical and

[111] "That is why potlatches are given, so the records are kept straight. People will stand and recite exactly where that name and that song comes from and how come they have the right to use it. Everyone present, because they are present and paid as witnesses, is to remember that and remember it correctly" (Joe David of the Clayoquot band, for whom a potlatch was held by Robert Davidson, Steltzer, 1984: 57).

sexual abuse (TRC, 2014), and the schools were designed to scrub children of their Haida heritage and traditional knowledge. Speaking the Haida language was often a punishable offence. As Participant Dexter Simpson reflected, "*they sent me out to be a white man and I learnt my lesson well. Then I lost all my language and everything. I used to go to my Nonni's [grandmother's] every day, and all she spoke was Haida. But then I went to residential school and boy if you spoke your language there*".

As told in Tara Samuels' story 'The Stolen Generation'[112] (Samuels, 2012), the trauma of this experience was felt back in Haida Gwaii, as well as by students. During my time in Haida Gwaii people spoke frankly with me about their experiences wirh the legacy of this 'cultural ethnocide' (c.f. Stavenhagen, 1990) and to be told such stories was a great honour. These were personal accounts, not data, but others do not need to look far to begin uncovering relics of this trauma that reverberate around Haida society today (see, for example, Box 5.16)[113]. Having experienced first-hand some of the many legacies of colonialism in Haida Gwaii, condensing this complex and deeply meaningful personal engagement into such a whistle-stop, and frankly inadequate, tour of Haida colonial history nevertheless feels like its own kind of quiet violence.

> "The other things I keep thinking about as I work healing myself are the things that really affected our people — the latest wave has been residential schools and the fall-out from that which is alcoholism, abuse, drugs and now there's HIV/Aids. Just take a moment and think about those things and what they did and what they are still doing to us. When I talk with people some of them can't understand why they feel the way they feel, and I think, oh lord, that we have any feelings left is amazing… Today, even though we weren't physically part of the epidemics, we still suffer the consequences and the ingrained sadness that a lot of people suffer from can lead to depression, alcohol, abuse and other things — people are looking to get their power back. We have people who are able to stand up at a feast and talk about all of these things and not cry. I remember the times I have stood up and cried, but as I heal myself and try to understand where I have come from, I believe I have been blessed, because I was able to recognize that I needed help".
>
> - Kii'ijuus Barb Wilson (CHN, 2009a: 8).

Box 5.16

[112] "Grandmother could see something bad was happening to her people and she wept. She was weeping because she looked around and all of her children were gone, there was great loss of culture, transitions and customs. The village was sorrowful. She had seen this kind of destruction before and she was very worried. She remembered back to when almost all of her people passed away from disease and many villages became unpopulated. There was no more regalia, cedar dressings, no more drums, no more singing. There was no pride to be felt anymore. If there were any kind of Haida celebration there would be high consequences to be paid if an Indian Agent caught anyone. The village not only felt empty because there were no children playing and speaking Haida but there was also an emptiness because their identity as traditional Haida people was at risk" (Samuels, 2012).

[113] Testimonies from residential school survivors from across Canada were collected by the Truth and Reconciliation Commission (TRC, 2014) and stories are also expressed in more recent Haida art. "'We were once silenced' [is] a totem pole [that] Robert Davidson carved to tell the story of when the Haida people were robbed of their culture – banned from speaking their language and practicing traditions such as the potlatch, with children forced into residential schools" (Globe and Mail, 2014: 5). For a social science account of this legacy see also Pearce et al. (2015).

5.6.6.2 The "Reawakening"

In the face of these challenges the Haida Nation has shown incredible strength and resilience, and has unrelentingly fought to restore Haida rights, traditions and cultural identity lost to what Jisgang Nika Collison has called "the silent years" (Collison, 2011). Robert Davidson, an artist whose work has been central to this revival, has described "what's happening now" as "like a reawakening" (Gill, 2009: 250).

To offer just a few examples, although the Haida language remains highly endangered[114] language regeneration efforts are concerted and dedicated, as are cultural rediscovery programs such as the T'aalan Stl'ang Cultural Camp (haidahealth.ca, 2014). As well as reestablishing a vibrant art culture, the Haida have repatriated many cultural treasures that were appropriated and put into museums and collections around the world (Krmpotich & Peers, 2013).

Today potlatches are also held at appropriate moments and the Haida have their own provincial and federal governments. Haida political activism has established renowned legal precedents in relation to First Nations title and land management. As title negotiations continue co-management remains a compromise for the Haida (Lee, 2012), however cooperative management has largely replaced unilateral decision-making (Takeda & Røpke, 2010).

This success is perhaps most poignantly captured in the 1980s Athlii Gwaay (Lyell Island) protests and the 1985 blockade against clear-cut logging. These protests lead to the 1988 South Moresby Agreement (CHN, 2010b), the establishment of Gwaii Haanas National Park and the 1993 Gwaii Haanas cooperative management agreement. This agreement provided for an unprecedented government-to-government power sharing arrangement in which both governments had equal representation and retained their own rights (Government of Canada & The Council of the Haida Nation, 1993)[115].

As a result of this campaign, today around 52% of the land base of Haida Gwaii is protected by the 2007 draft Haida Gwaii Strategic Land Use Agreement (CHN & BC, 2007) and the rest is at least theoretically subject to cooperative 'ecosystem-based management' protocols (CHN, 2010b; CHN & BC, 2007)[116]. The significance of this event is expressed in the Haida National Anthem, known

[114] There are fewer than 40 fluent speakers left and most are over 80 years old, but many work tirelessly to keep the language alive through teaching in schools, mentoring programs and the development of a range of audio-visual material (Steedman & Collison, 2011)

[115] See also May, (1990) and for a chronology of events see CHN (2010b).

[116] Progress can also be seen in such recent successes as CHN closure of the Herring fisheries around Haida Gwaii amidst concern about fragile recovery (CHN, 2014b). On-island logging is now at a third of its former rate, with more responsible practices including reforestation obligations and protection of riparian zones enforced. The Haida owned company HaiCo also owns Taan, one of the largest forestry companies in Haida Gwaii (HaiCo, 2012).

as the Lyell Island song, as well as in the 2013 Legacy Pole (Parks Canada, 2014) raised at Windy Bay (Figure 5.3): The first pole to be raised in Gwaii Haanas National Park for over 130 years.

Figure 5.3: Protestors at the Athlii Gwaii blockade depicted on the Gwaii Haanas Legacy Pole, in preparation at the Haida Heritage Centre at Kay Llnagaay.

The pole was carved by Jaalen Edenshaw of the Ts'aahl - Eagle Clan (Jaalen.net, 2014).

5.6.6.3 How the Post-Colonial Context of Haida Gwaii May Have Shaped the Reception and Vision of the HSRC Project

So how may this history of Haida suppression and dispossession, and the subsequent fight for cultural revival, have influenced support for the HSRC project? Well clearly it did not do so in any uniform way since, as has been intentionally reiterated several times, while Old Massett voted to finance the project, the decision to do so was far from unanimous. There is however evidence to suggest that for some the HSRC project tapped into the ongoing desire to rekindle greater Haida autonomy and cultural identity.

We've seen already how for some the salmon restoration goals of the HSRC were understood to offer a chance to restore access to a culturally treasured, and economically significant resource, fundamental to Haida self-sufficiency and identity (section 5.6.3). I've also discussed how some participants perceive anthropogenic climate change to be a further threat to Haida livelihoods and cultural identity and how the potential income from carbon credits was sought by some to help address ongoing social and economic challenges faced by Old Massett (5.6.5). However an important elaboration to this latter rationale was the perceived potential for Old Massett to create it's own economic engine and break-free from financial dependency on the Government of Canada (see Box 5.17).

"*We're a First Nations band in Canada… A 'reserve' in Canada means that Old Massett doesn't own the land we're sitting on here. It's owned by the Federal government… This is British Empire stuff. So to some extent this has been my whole aim for the last close to eight years, is to convince Council, they're convinced now, that we need to get out from under what I call the INAC box, which is Indian and Northern Affairs Canada and get into the corporate box. Because that's the only way we ever have a hope of making our own wealth and therefore getting our independence. So right now the typical First Nations of Canada, you're under the control of the Federal Government*"

- Participant Raymond Wallace

Box 5.17

Section 5.6.2 discussed how a project theoretically aimed at environmental protection or restoration was seen by some as more compatible with the deep cultural and spiritual connection to land taught in Haida oral history, than was the resource extraction economy typical of the islands. This sentiment may have been particularly pronounced in the case of the HSRC since marine co-management initiatives are lagging behind land provisions (CHN, 2007; Jones et al., 2010).

Linking environmental degradation with neocolonial destruction of Haida culture and self-determination, here we saw how assaults on the land were for some an attack on Haida identity. This dynamic was perhaps best captured by Participant Chris Shaw who explained, "*being Haida is being the ocean. If we don't have the ocean, we are not Haida*". Section 5.6.1.1 also suggested that for some the HSRC project was perceived as facilitating management of the land and resources that the Haida had previously been disempowered from (see Box 5.18).

"*First Nations values is taking what you need and giving back twice as much… But it's tough being stewards of the land when our governments and our country is taking a complete opposite direction of taking away that stewardship and putting our land at risk with basically every move they make*"

- Participant Brent Morton

Box 5.18

In section 5.6.4 I also suggested that for some inaction on anthropogenic climate change and subsequent climate risks were perceived as another way in which the federal and provincial governments of Canada have let the islands down. Further many of those who live on Haida Gwaii report a more general feeling of isolation, which finds expression in a host of social and economic domains[117]. Participants also commonly reported an accompanying lack of trust in the Canadian

[117] Situated on an active fault line there is for example significant interest in community-led earthquake planning in Haida Gwaii, which is perhaps due in part to the sentiment expressed by Participant Tommy Day: "*If there is a big event in the Pacific North-West we will be the last people that anyone comes to help*". This feeling of isolation has contributed to previous OMVC initiatives, for example, to monitor radiation after the 2011 Japanese tsunami (Observer, 2012b), as well as ambitions for local weather forecasting provision. As one Old Massett Village Council representative explained, "*we monitor the weather and you know, living out here on the very Western-most point out in the ocean, usually what happens is that when they saw what is happening to us, then they could predict*

government. For a community that has fought for every inch of its autonomy, against a government which they feel has failed to look after the interests of their people or of their land this is perhaps unsurprising. Yet exacerbating this distrust is ongoing Indigenous disadvantage[118] and accusations of Prime Minister Stephen Harper muzzling government scientists (Chung, 2013; Turner, 2013). Adding further fuel is the Enbridge pipeline proposal to bring oil from the tar sands in Alberta to the Pacific Northwest, and ultimately oil tankers into the waters of Haida Gwaii (northerngateway.ca, 2014). An initiative which has been passionately resisted on island (see Figure 5.4), HSRC lawyer Jay Straith's characterization of the Harper government's agenda was qualitatively not atypical: "I *don't think the government really wants the native salmon to come back. There is nothing for the oil tankers to pollute if there are no wild salmon*" (Observer, 2013a).

Figure 5.4: Enbridge pipeline proposal protest banners in Old Massett

Such distrust and isolation appears to have intensified Haida ambitions for autonomy, instilled a need for self-reliance, and fueled the perception that local residents must themselves take action to

pretty good what's going to hit Prince Rupert, which is about a day ahead. So they have really good forecasts for Prince Rupert. But for us, a lot of the time we are like testing ground… So what I'd do is I'd make those weather buoys some of them are quite a long ways offshore, like a hundred miles or more, so I'd just I'd have barometers and everything and I'd put together my own understanding of what's happening".

[118] See for example Native Women's Association of Canada, (2007), Goudreau & Wabie, (2013) and Oppal (2012)

protect their environment from environmental threats like climate change and depleting salmon stocks. As Participant Brent Morton explained, "*we were going to make… sort of a documentary about [it]. We were pitching it as the idea of this tiny village taking on such an enormous project, which it really was. Taking on such an initiative to help change the world, for better and trying to find a solution instead of, you know, being part of the problem*".

This pursuit of autonomy therefore perhaps contributed to this sense of individualism that pervaded the HSRC's justification of the HSRC project (see Box 5.19) and that added up to the appealing proposition that the HSRC and ocean fertilization could be *the thing* that could help save Haida Gwaii, and possibly even the world, from climatic disaster

"*What the project was about was a marine science research project, to figure out how the oceans work, so that we can put together a plan to start fixing them. We would never get all the answers, but you know we've, like some of the things that we've discovered out there, and we still haven't got it out there yet, but we've shown snippets to people, it's going to turn marine science on its head. It's crazy. So here's this tiny little community in the middle of nowhere that's sitting on this wealth of information that is going to change science*"

- Participant Raymond Wallace

"*When no one else is acting to curb the problem of climate change, we have a responsibility to do experiments like this, to seek solutions". This is "a right and an obligation*"

- Participant Rob Peters

Box 5.19

There are a couple of other notable ways in which the HSRC project interacted with ongoing ambitions for greater Haida autonomy. Firstly, by applying to OMVC for its research permits, the HSRC, at least ceremonially, respected Haida title in a way that the Canadian government generally has not (see Box 5.20).

"*We've got our approvals right here. Have you ever seen these? Those are our oceanographic research permit, our atmospheric and climate research permit, all issued by the Old Massett Village Council. They are the only people that live there. It's part of their traditional territory. They never ceded… sovereignty. Why can they not issue those? They can*"

- Participant Rob Peters

Box 5.20

Former President of the Haida Nation Guujaaw is reported in Gill (2009: 229) to have been unimpressed when a Hereditary Chief sought permission outside of the Haida Nation to set up a fishing lodge in Naden Harbour. "*He went and asked the province, not us*", Guujaaw stated, reaffirming

that the authority of the Haida Nation needs to be respected across all island affairs. So for some the HSRC's attitude towards Haida title could have been seen as refreshing.

Secondly as demonstrated in Box 5.21 below, some saw resistance to the project as an extension of discrimination and oppression experienced by Haida people. Participant Rudy Cooper for example suggested that the scientific community's heated reception of the project emerged because "*they weren't in on it*". There was "*no hell raised*" about previous ocean fertilization experiments he said, "*because it was the governments doing it*". The idea that this resistance was a double standard persisted among many participants. Indeed for many it was neocolonial in intent. For these participants, resistance to the HSRC project was yet another way in which Haida autonomy is being suppressed and for some participants such rationales linked the HSRC project with Haida self-determination.

"*[This project has been controversial outside of Haida Gwaii] because white people like controlling natives and they don't like them doing things without permission. And they don't like them spending money without being told how they can and can't do it*"

- Participant Russell Anderson

"The question that should be asked is why is ETC from Montreal, a fringe NGO group with zero marine science background sending their policy guy to lecture us about our work? Who invited them? Under what authority do they base their right to dictate to us the best way for us to move forward, when we are facing catastrophic environmental losses due to declining ocean health right in our own back yard?"

(OMVC, 2013)

"*I guarantee the Canadian Scientists are looking at it. I don't doubt that one bit… They are mad because the Haida's did it before them. That's what it's all about... They are probably saying 'why didn't we do it?' Of course it's money*"

- Participant Joseph Willis

Box 5.21

5.7 Why Was the HSRC So Controversial in Haida Gwaii?

"*I can guarantee they would never get away with doing that again. Not if the public knew about it because I've got a list of guys – My boat would be first in line to ram them and put them out of commission. You think Paul Watson would let them get away with that kind of shit? The Ocean Pearl would have been sunk out there*"

- Participant Harry Doyle

Box 5.22

As discussed, the HSRC has been deeply divisive on island, and has provoked strong, emotional reactions in resistance to, as well as in support of, the project (see, for example, Box 5.22). Section 5.6.1.2 noted that for many the project was seen as incompatible with ambitions for environmental protection and stewardship. The reasons for this are multiple and diverse. Some participants for example reflected ideas documented in previous research on public perceptions of geoengineering

and suggested that ocean fertilization represented an unprecedented and undesirable human intervention into what we think of as 'nature' (e.g. Corner et al., 2013), while others considered the project to be too risky (see section 5.7.3 below). For some Haida residents the project was therefore seen as incompatible with teachings from Haida oral history.

Most of these objections will not be explored in more detail here since the following two chapters of this thesis will focus on this dynamic; exploring the way in which participants constructed diverse storylines about nature and human agency in order to prescribe different roles for ocean fertilization. During this analysis I will attest that at the heart of debate in Haida Gwaii about the desirability and feasibility of ocean fertilization are contrasting accounts about the nature of 'Nature', planetary limits, the stability of nature, the types of knowledge that can be acquired about nature, the types of knowledges which count, the value of 'Nature', the types of 'Nature' that have these values, as well as contrasting interpretations about the role and nature of the human being, and their capacity and responsibilities. There are however a number of other challenges to the HSRC project which warrant brief reflection.

5.7.1 Scientific Validity of the HSRC Experiment

5.7.1.1 The HSRC Makes Grand Claims

The HSRC have attributed a 35,000 square kilometre bloom, observable from Space between August and mid-September, to the iron they added to the ocean eddy in the summer of 2012. Using Slocum underwater gliders and a range of other primarily ocean chemistry based data collection techniques[119], Participant Raymond Wallace claims the HSRC has collected "*the biggest body of marine science data that the world has ever known*". And although some HSRC affiliates have drawn more tempered linkages than others, the HSRC have made a number of grand claims about both carbon sequestration and the salmon restoration successes to arise from their project. Participant Raymond Wallance continued, for example, "*we still have to analyse a lot of [the data from the slocum gliders]. But… it's just like, you open up folders and just sort of read the introduction you know, you get a snapshot… we can't have sequestered less than 5 million tons. There's no way. It could be enormously bigger than that, but it can't be less than that*".

Following higher than expected returns of pink salmon in the autumn of 2013 (Hume, 2013)[120] a HSRC lawyer additionally told the Haida Gwaii Observer that Old Massett's project should receive the credit for these runs. "That proves that, at the very least, we are right", Mr Straith reportedly said, "the theory is substantive and it is legitimate science" (Observer 2013a). Others too have associated this run with a narrative of their project's success. "*In my heart I'm confident that our project*

[119] See HSRC, (2014b) for a full list of the HSRC's data collection techniques.
[120] Notably pink salmon was not the species of salmon whose migratory route the HSRC project originally explicitly aimed to intercept with their bloom.

was at least partially responsible… Because what did change? We know what the plankton conditions were the year(s) previous, and the years past, we've got all the data. We know that nothing really changed other than that. So certainly I'm sure that we are all partially responsible for that" (Participant Rob Peters).

The initial hype around the 2014 Fraser River sockeye runs, estimated at 20.7 million fish (Hume, 2014), supplemented these claims. "As far as people of Old Massett are concerned, there is only one jury that will decide whether or not this experiment is a success or not and that jury is out right now, in the North Pacific, and it's going to constitute millions of salmon. They will render their verdict in the summer of 2014" HSRC lawyer Jay Straith had claimed at the 2012 HSRC press conference at the Vancouver Aquarium. For some of those who perceived the 2014 salmon runs to be the primary indicator of the project's success, this jury has rendered its verdict.

"Those baby sockeye salmon that year swam into an ocean of health and abundance and instead of mostly starving were treated to a feast", Russ George writes on a section of his blog titled, "And Yet It Works!". "The vital role of healthy ocean pastures for Pacific salmon is now unequivocally proven… This year's miracle of salmon abundance isn't an accident of nature, it is an intentional act of nurture… By nurturing the ocean salmon nursery pastures we have brought back the fish" (George, 2014).

5.7.1.2 Contestation About the Validity of the HSRC Experiment

The validity of these claims has however been widely called into question, and the potential for the HSRC experiment to obtain meaningful data about the impacts of iron fertilization on the ocean ecosystem and to measure carbon sequestration, remains highly contested (see Box 5.23).

> "I think that in all the controversy about iron fertilization, whether the Haida Salmon Restoration Corporation's (HSRC) project is a valid science experiment has been lost. It is not. Science is asking questions and rigorously and critically answering them. While the questions and questioners may vary, there is only one scientific method. There is no evidence HSRC followed the scientific method. Their measurements are useless to answer any ecological questions. In the case of an experiment where you add an element (e.g. iron) you need a control for comparison. Further, your proposal is peer-reviewed and so considered valid before you receive any funding to conduct the research. At no time has the HSRC produced a peer-reviewed proposal written before the experiment was conducted with their experimental design and statistical analyses" (Pearson, 2013a).
>
> *Box 5.23*

David Keith called the HSRC project "hype masquerading as science" (Hume, 2012). While Suzuki (2012) demanded, "how dare we call the iron scheme an "experiment" or "science?" It is not; it is a stunt. To assess a scientific experiment, you need a baseline… Otherwise, we have no idea what actually happened that can be attributed to the iron dump. The only way to measure long-term "success" is by monitoring populations of plants and animals, not for days and weeks, but for

months and years". These concerns similarly infiltrated engagements with interview respondents. "*His [Russ George's] science is being held up as very dubious*" Participant Kelly Baker attested, for example.

Yet Buck (2014a) asks rhetorically of this project, "who decides what is legitimate science?", reflecting the understanding that scientific legitimacy is itself constructed (Latour & Woolgar, 1986). This epistemology, compatible with that discussed in section 3.6 of this thesis, means I will be similarly unable to provide an authoritative response to Buck's question. What I can do however is offer an interpretation of some of the ways in which the scientific legitimacy, or illegitimacy, of the projects research design was constructed by participants. Here a number of notable themes emerged from participants' responses.

Of primary concern among respondents was discussion of the validity of the HSRC's experimental design. Geoengineering literatures that highlight the difficulties of measuring the impacts of ocean fertilization on the ocean environment were drawn upon by participants (c.f. section 5.1). So too were findings that challenge the effectiveness of ocean fertilization and the linkages between ocean fertilization, carbon sequestration and ecosystem productivity (see Box 5.24).

"As far as I can tell from the available public information, you do not as yet have a valid experimental design. Adding iron to the ocean is not a valid experimental design because you have no controls; areas for comparison with no iron added. Without a control, you have no way of knowing if the effects you observe were a result of adding iron or would have happened anyhow. You also need replicates (many different measurements), both in different locations and at different times of the year. As I am sure you know, the ocean is not the same in every location or in every season… Further, there is no pre-treatment monitoring evident; establishing a baseline to determine background conditions"

(Pearson, 2013b)

"Without the base line information, any data collected would be worthless. Maybe Russ George didn't realize how important it was to do this before dumping the iron. It was never mentioned, at any meeting, that they were in the process of monitoring the Haida Eddy"

- local resident Gloria Tauber (in Observer, 2014a)

"John Disney told us in the informational presentation, "Salmon eat Plankton!". It is important to note that Salmon do not eat Phytoplankton, which is what is hoped to be produced by the addition of iron. They do eat some of the species of zooplankton (which can eat phytoplankton, or each other depending on the species), and so it's a matter of whether the zooplankton are there and then reproduce to be abundant when the Salmon need them. Maybe there is a link, but one would need to ask a fisheries biologist, not simply check a satellite map indicating the location of Phytoplankton Blooms, which have not decreased in the NE Pacific [Harrison, 2002]. So, one needs to know precisely both the Sockeye Salmon/Salmon migration routes and the timing that they will travel through area fertilized area. In other words, the fertilization site needs to be accurately selected and precisely timed to meet specific requirements to have any possible effect on enhancing Salmon. It does not seem to be simply a matter of, 'If you build it, he (in this case, Salmon) will come'".

(White, 2013, original emphasis)

Box 5.24

That these literatures have at times been entirely dismissed by HSRC and OMVC representatives added further fuel to this fire. An Old Massett Village Council newsletter, issued in response to meetings scheduled on island by ETC Group representative Pat Mooney, was drawn upon by several respondents to illustrate this conviction: "ETC Group **Lied by saying** there is scientific uncertainty regarding the permanence of carbon that sinks into the deep ocean. FALSE – a recent paper (in the Journal NATURE July 2012) by Smetacek et al shows otherwise based on the same work as ours" (OMVC, 2013, original emphasis).

The limited opportunity for longitudinal measurement and the apparent absence of baseline measurements were often at the heart of participants' objections to the HSRC's research design and in some ways these concerns were substantiated by some HSRC affiliates. It has been claimed that Craig Mewis, a young science graduate hired by the HSRC to help measure the impact of their experiment on the ocean environment, resigned during the HSRC's first voyage because of concerns about the lack of monitoring of ocean conditions prior to the iron deployment (McKnight, 2013b). While, during interviews, other HSRC-affiliated respondents reluctantly expressed concern that depleted funds in the HSRC had prevented further monitoring of the ocean environment, and confessed their own wavering conviction that sufficient baseline data had been collected (see Box 5.25).

Russ George was frequently drawn into these narratives and several respondents echoed the HSRC counter-claim that contends Russ George and his company Ocean Pastures Corp. had claimed to possess the expertise, proprietary knowledge and technical "*know-how*" necessary to execute and capitalize on an ocean fertilization venture (Vancouver Registry, 2014). The insinuation being that they had deferred to his ostensible authority, perhaps to the detriment of the validity of their research design.

> "*Again if you were asking me in my heart or in my brain, did we collect enough baseline, I'd say no. It's one of the reasons that we're having this big problem with Russ. I mean he didn't want to collect any. He just wanted to get out and do it. He is that guy… If I was there none of that would have happened… We would have just collected baseline data and Russ would have had to try and push me around. Which wouldn't have happened…. But in hindsight you know Russ – Again Russ represented to us that he knew what he was doing. Russ represented to us that he was a world-leading expert*"
>
> - Participant Rob Peters
>
> *Box 5.25*

Other HSRC affiliates reported being certain that through the use of Slocum gliders the corporation had obtained the necessary information to make a meaningful evaluation of the impact of their project on the marine environment (see Box 5.26). However these claims attracted

controversy from others less convinced by the power of such one-off data-gathering missions. The only paper to date to report the results of these glider missions exacerbated these concerns (Bird et al., 2013). A methods paper exploring the use of Slocum gliders as ocean measurement instrumentation, this paper suggests that the HSRC only used the gliders to measure the Haida Eddy's physical properties after fertilization.

"*The way I understand it looking back is that Russ finally, for the first time in his life – for the last sort of 12 years leading up to this, this is what he was trying to do – and Old Massett had given him the means to do it. I think he got too excited and he wanted to just sort of cut straight to the chase. And you know Craig Mewis was a very very smart guy in his field and I think the other end of the spectrum was that he probably wanted to get a little carried away the other way. He wanted to have masses of baseline. But at the end of the day, for what we did, we did two ocean voyages… and the secret was those gliders. Craig Mewis would have been much happier if they'd spent you know three quarters of that first trip just collecting that stuff. But the gliders produced so much more. I mean the amount of data in those things is nuts*"

- Participant Raymond Wallace

Box 5.26

Other concerns about the credibility of the project arose when existing local knowledge of ocean conditions held the location of the experiment research site to be incompatible with the project's alleged experimental design; to supplement an iron replete area in order to boost primary productivity. For example as seen in Box 5.27, some participants suggested that the Haida Eddy where the iron was dumped is not iron limited, that blooms happen naturally in this area and that subsequently there was no way of telling whether or not this bloom would have occurred without the iron supplement. A further group of participants contested the premise that the problem leading to declining salmon runs was 'at sea', suggesting insufficient stream restoration work has been done to repair the damage caused by logging in riparian zones and that this is where efforts should be focused.

"The area that they chose to do the dumping in was a place that was already frequented by natural algae blooms"

- Participant Charlotte Elliott

"*It [the plankton bloom] happens every year. It happens several times a year… They have no way of measuring whether it had anything to do with what they dumped. Because they happen all the time… Nothing to do with those clowns. It's been going on forever… It's been known for a long time [that the Haida Eddy] is one of the most nutrient rich spots on the planet. Like if they wanted to do some kind of experiment, why didn't they go somewhere where there's fuck all, you know, nothing out there… You know some of the statements they made were, 'oh it's a dead zone out there, there's nothing living'. They are so full of shit. The only reason they could sell that is because nobody goes out there. I mean who goes 200 miles offshore? I bet there are only five people on the islands that have ever been 200 miles offshore and I'm one of them… they are trying to take credit for all the pink salmon that are returning this year to the Fraser River. Well guess what, if these guys are all so fucking intelligent, the pink salmon don't go anywhere near that far out there"*

- Participant Harry Doyle

Box 5.27

In addition, some respondents argued that the area fertilized had been chosen primarily to situate the dumping outside of Canadian jurisdiction and had little connection with sockeye salmon migratory routes, which are poorly understood[121]: A circumstance partially acknowledged by HSRC Participant Raymond Wallace "*I had to be very firm with the skipper… I said 'I absolutely forbid you to dump inside the 200 mile limit'… I said 'look, we've come too far and I've had too many sets of lawyers. I said the key here is to stay outside this limit, because then we can get on with doing what we want to do'. And also actually for the fish and that, like the DFO [Department of Fisheries and Oceans] don't actually know that much about routes, they pretend they do but they don't know that much. But a little further out would have been better, we figured*".

As Old Massett band member SGaana Jaad April White argued, for these respondents it was understood that "any salmon enhancement would've been coincidental rather than by design" (White, 2013). Dr Skip McKinnell from the North Pacific Marine Science Organization writing in the Haida Gwaii Observer, further challenged this linkage in relation to the 2013 plenteous pink salmon runs. "If I was seeking a potential cause for these widespread high catches I would consider a much larger geographic scale than a point-source supplement that was located outside of the range of what is known of the juvenile pink salmon migration", McKinnell (2013b) wrote. Others claimed the HSRC experiment was intentionally timed to coincide with the progeny of the '30 million strong' 2010 sockeye salmon run returning to Haida Gwaii (see Box 5.28).

[121] "McKinnell states "the period between when Fraser River sockeye are migrating northward along the continental shelf and when they appear in deep water is one of the least understood periods for these animals, in part because logistically difficult winter sampling is involved'… If a person, whose career is fish science, says a part of the migration is least understood, how could HSRC and its team purport to know exactly where to locate the site of an Ocean Iron Fertilization experiment to enhance Sockeye Salmon?", Old Massett band member SGaana Jaad April White asked in her 2013 submission to Old Massett Village Council (White, 2013).

"Regarding your front page story on the Ocean Fertilization Project… [the HSRC] implies that their project will be responsible for the anticipated big run in the Skeena River next year – something that all fishermen, including John Disney, are aware happens in cycles and 2014 is slated to be a big year! The timing of the dump was, no doubt, carried out with this in mind, to take credit for this!"

(Local resident Gloria Tauber, in Observer, 2013b)

Box 5.28

A lack of transparency surrounding the experiments design, methodology, implementation and data collection fueled many of these concerns (see Box 5.29). As did the lack of traditional academic credentials among the HSRC affiliates. "*I don't even call it science, because it wasn't science. There wasn't a scientist - how can they call it science when there wasn't a, there was no scientist there? Russ George calling himself a scientist? He doesn't even have a degree*", Participant Harry Doyle, argued.

"Real science doesn't happen in secret", Professor John Cullen of Dalhousie University argued of this project on CBC's Fifth Estate

(CBC, 2013).

"*There should have been a formal proposal with background from the literature and research question, experimental design and proposed statistical analyses based on the experimental design. All statements and choice of experimental design and statistics should be substantiated by citations from the scientific literature… There should also be evidence that the project was reviewed before it was actually conducted. If it was not peer-reviewed before the actual experiment took place, then HSRC did not follow the scientific method*"

- Participant Valerie Collins

"*In the newsletter yesterday it said only Haidas with their band number are allowed to go into the meeting, when this effects [everyone]. Anybody who lives up town, anybody off island who wants to come to this meeting about the iron thing should be involved in it. They shouldn't be picking out the only people you want to go there. It's trying to control whose going to speak*"

- Participant Ricky White

Box 5.29

The way in which the HSRC continued to label their project as 'top-class science" by "*five-star*" and "*world-class scientists*" (see Box. 5.30), further exasperated some respondents. Through these labels the HSRC sought legitimacy and credibility – and arguably legality (*Nature Geoscience*, 2009) – and deferred to the idea of scientific rationalism, to justify their project and to dismiss critique as illogical. But for some critics these narratives were "*self-serving, unverifiable claims*" (Participant Marianne Dunn), constituting nothing more than "*smoke and mirrors*" (Participant Kelly Baker) and exacerbating objections to the project.

"*I found it so inspiring to work with people of that caliber… working with those people is just astonishing… I'm always looking for where's the landmine… where's it going to go wrong? I asked everyone on that boat so many times, 'did you see one negative side effect, one thing? Any tiny thing? You have to tell me, because if so we have to mitigate it right now, we can't go on doing this stuff unless we know of it'. And they kept saying 'no, no'. So that's what I was always looking for. But these guys in my mind, if they are satisfied that we are not doing anything to harm - that's my biggest concern that we're going to do something to harm the environment – through all of this so far I've kept asking 'are we doing anything to harm the environment, because if so we have to address it right now, it's our priority'. And they kept saying 'no'. If they are excited, with their intelligence, saying 'we're doing the right thing' then that's good for me*"

- Participant Raymond Wallace

Box 5.30

With no peer-reviewed results from the project yet available, the burden of proof remains on the HSRC to prove their claims respondents explained. However many agued that there is little to suggest that the project will meaningfully evidence carbon sequestration or salmon restoration. Participant Russell Anderson, for example, constructed such a storyline: "*I mean if you're driving down the road and your car stalls you don't just take the doors off, because you're like 'we've gotta do something. Quick. Let the air out of the tires. Just do something'. You know, you need to plan. Like what's the plan here?… they claim to have everything they need. But you know, I haven't seen it. Nobody has seen it. That's just the thing right. You can't just do anything*".

5.7.2 The (Il)legality of the HSRC Experiment

Debate about the (il)legality of the HSRC experiment attracted further controversy to the project. Environment Canada has claimed ocean fertilization is not allowed under the 1999 Canadian Environmental Protection Act (Observer, 2013c): On the basis that the HSRC did not qualify as "legitimate scientific research" and no permit application system exists for ocean fertilization (CEPA, 1999). But while Environment Canada continue to threaten the HSRC with legal action, as noted above the HSRC deployed the iron in international waters with the intention of avoiding Canadian jurisdiction.

Commercialization of ocean fertilization is often also held to be inconsistent with international law (e.g. Freestone & Rayfuse, 2008), but in reality this too is a legal grey area. Citing the original UNFCCC convention text[122] Participant Rob Peters argues the United Nations Framework Convention on Climate Change (UNFCCC, 1992) has accepted mitigation actions and he extends

[122] "The Parties should take precautionary measures to anticipate, prevent or minimize the causes of climate change and mitigate its adverse effects. Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing such measures, taking into account that policies and measures to deal with climate change should be cost-effective so as to ensure global benefits at the lowest possible cost. To achieve this, such policies and measures should take into account different socio-economic contexts, be comprehensive, cover all relevant sources, sinks and reservoirs of greenhouse gases and adaptation, and comprise all economic sectors. Efforts to address climate change may be carried out cooperatively by interested Parties" (UNFCCC, 1992).

this to include ocean fertilization, despite the UNFCCC currently only recognising forestation and reforestation as carbon sink projects: "*That United Nations document says we have to do these things. We must go out and do things*" (Participant Rob Peters).

Participant Rob Peters is highlighting some of the definitional challenges associated with existing geoengineering legal frameworks (c.f. Heyward, 2013), and indeed there are currently no legally binding bans on ocean fertilization in international law. There have however been statements expressing disapproval of ocean fertilization from both the London Convention on Ocean Dumping (IMO, 2006) and the Convention on Biological Diversity (CBD, 2009) and campaigns to get this disapproval articulated in a legally binding ban on the practice have occurred within both fora (Williamson et al., 2012).

HSRC affiliates claim the corporation to have identified a legal "*loophole*" (Participant Raymond Wallace). While many critics have accordingly characterized the HSRC as "*rogue scientists*" (e.g. Participant Martin Clarke), objecting to the HSRC's individualist narratives, discussed in Section 5.6.6.3, that espouse a libertarianist freedom to act in the global commons (see Box 5.31).

"*When 192 countries of scientists are saying no, and then you have this one guy come in, who's not a scientist, who's a business man, who hasn't proven a darn thing, doesn't have a scientific baseline, that's nuts… Did they talk to the First Nations people on the coast? No. Did they talk to the First Nations people in Alaska? No… We are not separate of the world. What happens here will effect what happens in Japan. China already we know what is going on out there with their oil leaks and their rigs and stuff is already affecting us. You know these things, we are not in isolation. But had they gone to the community of the world, there was opportunity. It is in there that you can make applications to do small experiments… We have Title and rights on our territory. But we don't have the right to infringe on other peoples, other nations"*

- Participant Joanna Cook

"*Those guys think they are smarter than the rest of the brains on the planet combined… They defied the world's scientific community. That's pretty arrogant*"

- Participant Harry Doyle

"*They would like it to work because then they could say we saved you, you owe us… [But] there's a worldwide moratorium through some group with the United Nations and that says we should not be doing this until we've figured some things out. Yet John Disney and company think 'we know, we've been on the internet'. Good shot John. They just ignore reality*"

- Participant Gary Bennett

Box 5.31

5.7.3 Risks of the HSRC

In an OMVC band members meeting, the HSRC are reported to have told Old Massett residents that they were "1000% sure that Iron Fertilization did no harm to the environment!" (White, 2013). However in much the same way as a number of participants drew on existing scientific and policy literatures to contest the scientific validity and the legality of the project, so too did many

participants draw on this literature to contest this assertion; arguing instead that the HSRC experiment bore significant, and for some unreasonable, risks to the marine environment (see section 5.1).

Highlighting that concerns about the wider ecological ramifications of ocean fertilization on the broader ocean ecosystem and food-web were often high (see especially White, 2013), participants raised concerns that ocean fertilization could produce or enhance toxic phytoplankton blooms (c.f. Silver et al., 2010; Smetacek & Naqvi, 2008; Trick et al., 2010). They also raised concerns that artificially induced phytoplankton blooms could block light from the lower ocean and cause oxygen depletion in sub-surface waters. Concerns that the ecosystem composition could shift to species that release more potent greenhouse gases than carbon dioxide were also raised and so too were concerns that artificially induced phytoplankton blooms could deplete nutrients in the surrounding water. Local environmental conditions, such as the extended closure of North Beach's razor clam fisheries, due to unusually persistent paralytic shellfish poisoning (Observer, 2014b), were therefore frequently linked to the HSRC project by participants (e.g. see Box 5.32).

"*You see they are taking credit for this big run of pink salmon this year. Well hey, go back in history books, it's a 2 year cycle. It's totally predictable. It's not a big surprise to anybody in the know. Yeah pink salmon are going to come back this year. Woop-di-do. We knew that ten years ago that this, this was a cycle year. It had nothing to do with them. You don't see them taking credit for, well how come there's the demonic acid up on North Beach? Unprecedented the levels. Never ever had levels like that, ever. Did it have anything to do with it? I doubt it. But I could blame it on that as much as any other environmental source. I've never seen a dead sea turtle in all my years at sea. I saw a dead one this year. Maybe it swam through the plankton and died. I don't know. They don't know. Two fin-back whales this year. Never ever seen one dead fin-back whale. This year we saw two. Maybe it was something to do with that, who knows*"

- Participant Harry Doyle

Box 5.32

5.7.4 Whose Project is this Anyway?

As discussed in section 5.5, the HSRC was an OMVC rather than a "Haida" project. However some respondents from Old Massett Band also felt a lack of ownership over the project. This was driven in part by the feeling among some that the vote to finance the project was not as democratic or transparent as is could have been. "*The way the decision to do our ocean fertilization project [was made]... it was a pretty dirty job*", Participant Brent Morton attested. "*They had a public meeting during dinnertime and hardly anybody showed up*"[123]. Due to poor turn outs in the preceding consultation meetings, some participants also suggested that not everyone voting was necessarily clear what they were voting for: "*Ten people went to their meetings, total. Everybody else who voted believed they were voting for something like a hatchery* " (Participant Joanna Cook).

[123] The HSRC have contested the accuracy of this portrayal.

5.7.4.1 Branding of the HSRC as a Haida Project

This feeling of lack of ownership was aggravated by the fact that many of the HSRC employees and senior management are not Haida, or even residents of Haida Gwaii. The project has also not been as closely overseen by OMVC as council projects typically are (see Box 5.33).

> "*The ideas that were brought forth weren't Haida ideas. They were brought forth by people outside of the community… It's not a Haida concept to begin with 'geoengineering' and… it's not our people being the scientists. Now if we were hiring our own people to do these studies it would be far different from spending our money on other scientists doing the work*"
>
> - Participant Jane Clarke
>
> "Must we follow HSRC Operations Officer, Jason McNamee as he 'tweets' the first public presentation of our data before informing us?"
>
> (White, 2013).
>
> "*This was like the very first time we [OMVC] ever kept business and politics away from it. I don't know if you know what I mean by that but… for instance [I'm a politician but] I'm involved with the work right and we don't want that. We are trying to break away from that so we're not hiring just our family and friends and stuff like that... So this is the very first time ever that our council ever just gave the restoration corporation full control and then all our council asked for was at the end of the week, or every two weeks, an update on what's going on… I just didn't feel like they were trying to keep us in the loop enough at the time. Like I understand we let them do all their business on the boat and everything else. Now the paper work is starting to be done, now is the time to keep us a little bit more in the loop*"
>
> - Participant Jack Larson
>
> *Box 5.33*

Yet beyond the title of the company, Haida oral history and cultural identity has been extensively woven into the company's branding and discourse as the HSRC has tried to align the Haida identity with its own. The HSRC website, for example, justified the project in terms of a Haida obligation to steward the land (see Box 5.7 in section 5.6.6.1 above).

Another example lies in the lyrics of the "Haida salmon song", "40 Million Salmon Can't Be Wrong" composed by HSRC Director Russ George; a Youtube version of which features local Haida art[124] (Wright, 2012). HSRC Participant Raymond Wallace was similarly revealing: "*All the environmental groups should be jumping up and down because one, it's a First Nation's group who is connected to the land. I mean they are almost living on the site, you know and they went out and tried to do something to fix the environment… Isn't there a whole bunch of positives here".*

Furthermore the experience of Indigenous inequality in present-day Canada (see section 5.6.6.1 and section 5.6.6.3) was drawn on by a HSRC lawyer to make sense of an Environment Canada raid of

[124] Some of which have been used without the artists' permission (White, 2013).

the HSRC offices in Vancouver where they "swarm[ed the] village science office with overwhelming force" (George, 2013c) and seized HSRC data. "That's how the Government of Canada responds to a First Nation doing scientific experiments", he explained (King, 2013b). While the HSRC website attested, "I am really getting tired of the way First Nations perspectives and practices are dismissed in the media…We need to ensure indigenous communities have an equal opportunity to contribute… The people of Old Masset Village have taken it upon themselves, at their own risk, to do just that" (HSRC, 2012).

This branding proved controversial since to some this discourse was understood as misappropriation of the proud Haida identity of environmental stewardship (section 5.6.1.1) and even a "*façade*" to hide behind, as for example Participant Kelly Baker suggested. "*They are non-Native, but they are really using this Native, Indigenous card, and it's frickin' pissing me off, that people are letting them do it… That really upsets me when you consider what we have done in the past and are currently undergoing to show that Indigenous ways of thought can really help. So to me it's an underhanded use of certain relationships and hiding behind them*". Other participants such as Charlotte Elliott went even further, suggesting that the land rights of Haida people, and the sensitivity of historical injustices against First Nations, were being used by the HSRC as a shield. "*John Disney and his cronies are hiding behind the Haida people because government tends to turn a blind eye when Natives are involved because they say they own the land and everything. So John Disney and his cronies are hiding behind them because they feel that they can get away with this project because they are using the Haida peoples name*".

Interestingly the "Haida" nomenclature of the HSRC project is not necessarily as manipulative as some respondents suggest. Instead for some, the Haida identity and the accompanying proud oral history and tradition of environmental stewardship, appear to have been used metonymically to represent a desire to use ocean fertilization to "*improve the health of the ocean*" (Participant Rob Peters) and to "save the world" (CBC, 2013) from the worst effects of climate change, that some of those who have supported the project described as compatible with Haida stewardship traditions. Whilst this justification of the HSRC's branding doesn't make the HSRC any more "Haida" *per se* it does demonstrate, unsurprisingly, that the notion of what it means to be 'Haida' is also constructed and contingent (Anderson, 1991).

5.7.5 Further Challenges to the HSRC

Just as a number of participants suggested the HSRC was trying to "*greenwash*" (Participant Jane Clarke) their project through the 'Haida' name, this logic was similarly applied to the salmon restoration ambitions of the HSRC. The HSRC came from the economic development arm of OMVC. Yet because of the access restrictions discussed in section 5.6.3, it was unclear to many residents how in the near-term Old Massett could benefit economically from any rises in salmon

populations. The cultural salience of salmon restoration was thus also described as an intentional ploy to win support for the project, and a guise from which to pursue carbon credits (see Box 5.34).

"*[It] should have been called the Haida carbon credit corporation… but… to get the Haida on board, the company made it about salmon. How it was presented, or how I saw it in the presentation, is strictly being about economic development with the mask of a science experiment and in particular bringing back salmon which is an emotional issue for the community because… for thousands of years, our life blood has been salmon*"

- Participant Jane Clarke

"We were and are being skillfully maneuvered into supporting the Project by well-known emotional, spiritual, and practical relationships that exist between the Haida - indeed all the First Nations Peoples of the Pacific Northwest Coast - and Salmon"

(White, 2013: 6)

"*It was never about global warming or about the fish. It was about selling the carbon credits to rich European countries and people were supposed to get a whole pile of money for that. He promised them that there'd be millions of dollars rolling in and there would be enough money to provide jobs for everybody and homes and that every urban Indian could return home to get a free house. That's what it was all about*"

- Participant Charlotte Elliott

Participant Martin Clarke: "*There is no, there is almost zero way for a First Nation or a community, to make money from salmon. Even if they had a zillion salmon come back through here, like they would – they don't have access – The access isn't there right. So where would they get the money*"
Participant Marianne Dunn: "*But that's not where the – It's carbon credit money they are after*"
Participant Martin Clarke: "*I know*"

Box 5.34

Adding further fuel to the fire, with no market or mechanism for verifying carbon credits from ocean fertilization currently in existence, it is unlikely that the CAD$2.5 millions dollars[125] OMVC originally spent on financing the HSRC – let alone the "guaranteed" profits from the project – will be returned to the village. For a community that following a drop in stocks can no longer heat its swimming pool (see section 5.6.5), as Participant Ronnie Stevenson explained "*that, was a lot of money*".

Other objections to the project echoed those reported in previous literatures on public perceptions of geoengineering. Participants for example reported fears characterized as the 'moral hazard' in existing literatures (e.g. Hamilton, 2011b). While some participants dismissed the *need* for ocean fertilization for geoengineering or salmon restoration purposes, rejecting the notion of an anthropogenic influence on current climatic and salmon population trends, and understanding them instead to be within the natural fluctuations of a dynamic natural system (see Box 5.35).

[125] A financial statement issued by OMVC in 2014 put spending at CAD$2.72 million dollars. But with ongoing expenses such as legal fees and Vancouver office rental, the final cost to Old Massett is likely to be significantly higher.

"*Nowadays it's the so-called global warming. Which to me is not a belief that I believe in. I believe it's just a cycle that happened a couple of thousand years ago and it's just coming back to what it was back then. Back then we didn't have machinery, we just had more volcanoes and other things. So to me I'm just of a strong belief that this is Mother Nature's way of cleansing itself. All the floods that have happened all over the world, it's just cleaning up what humans made a mess of… I think the Myans and ourselves had the same beliefs, that nature always comes back angry at some times for what other people do*"

- Participant Ricky White

Box 5.35

5.8 Where is the HSRC Today?

Using such data as satellite remote sensing measurements, papers are starting to emerge that are trying to estimate the impacts of the HSRC's addition of iron to the Haida Eddy. Batten & Gower, (2014) and Xiu et al. (2014), credit the HSRC with triggering a plankton bloom visible in satellite imagery in late August through September 2012). However partly due to the experiments' limited spatial and temporal scales, their estimates also suggest the total carbon drawdown of the bloom to be relatively insignificant, even "an order of magnitude smaller than that of the Kasatochi volcano and annually recurring Haida eddies" (Xiu et al., 2014: 46). Xiu et al. (2014: 45) estimate that "only a small fraction of the dumped iron was biologically used and converted to organic matter". Instead they concude that assessing the impact of the additional iron on ocean productivity, and the responses from the ecosystem at higher tropic levels and over extended periods of time, would be very difficult. These findings do little to quell anxieties about the impacts of the iron fertilization on the wider eco-system.

Importantly however these findings are only estimates, as the data available to Xiu et al. (2014) left the authors a long way from being able to fully assess the impact of the additional iron on ocean productivity and from being able to understand responses from the ecosystem at higher tropic levels and over extended periods of time. Quantitatively attributing causality between the bloom and adult salmon returns, against natural background variation would be very difficult, they conclude (Xiu et al., 2014).

As of the summer of 2014, the HSRC have offered to release their oceanographic dataset under the Open Database License and have actively sought assistance to explore their new research questions:

1. Does iron stimulate phytoplankton growth in a 2nd year Haida Eddy?
2. What are the ecosystem effects of increased phytoplankton?
3. Is there a positive impact on fisheries?
4. Is carbon sequestered and if so for how long?
5. Are there negative environmental effects and if so can they be quantified?

(McNamee, 2014).

These questions have moved the HSRC's narrative a long way away from such grandiose claims as the iron fertilization having "sunk enough CO2 to eliminate all Haida Gwaii's emissions for more than 300 years" (Observer, 2013d), that characterized the organisation's earlier public engagement. And more modest claims about what their data may reveal have emerged: "*There's a number of things to look at here. Did we take enough baseline? No we didn't. Should we have done more? Absolutely. Who's done any work in the open ocean? Who has any data at all? We do*" (Participant Rob Peters).

However with remaining questions about the projects experimental design, little money remaining to interrogate the data, the threat of two court cases pending (Globalpost, 2014), and an increasingly complex managerial structure designed to circumvent Russ George's continued authority within the HSRC's executive board, many respondents feel certain that a meaningful assessment of these research questions, along with promises of salmon restoration and carbon sequestration, will not be realised.

5.9 Moving Forwards: Contested Narratives About the Role of Nature and Human Agency

Clearly the HSRC has sparked an emotionally charged debate in Haida Gwaii. Yet as this chapter has begun to illustrate, arguably many of the reasons why the project has been passionately supported echo many of the reasons why it has also been passionately resisted. Respondents that constructed diverse narratives of the desirability and feasibility of the HSRC project commonly reported seeking a future in which environmental protection, healthy local ecosystems and salmon runs are ensured, where the risks of anthropogenic climate change are reduced and where the sustainability of Haida Gwaii and of the planet writ large are ensured. This chapter has also begun to reveal however that participants described diverse methods of realizing such a future and afforded different roles to the exploration of ocean fertilization.

This diversity offers support to the methodological decision to use the HSRC experiment as a case study from which to develop existing literatures on the anthropological underpinnings of geoengineering, since it suggests the case study may offer opportunity to examine multiple ways of conceptualising the relationship between ocean fertilization and the natural world. The following two chapters of this thesis therefore aim to move analysis of the HSRC beyond contestation of what could be described as the 'local politics' of the HSRC experiment. Instead focus will now shift to an exploration of how, in the performance of 'geoengineering', accounts of the HSRC construct diverse implicit ontological, epistemological and axiological interpretations of the role and condition of Nature and human agency.

Chapter 6: Framing Nature and Human Agency through the Haida Salmon Restoration Corporation

6.1 Contestation and Continuity in Accounts of 'Nature' and Human Agency in Discourse on the Geoengineering Ambitions of the HSRC

During analysis of discourse contesting the desirability and feasibility of the 'geoengineering' ambitions of the HSRC, I have engaged with a remarkably complex, rich and nuanced range of interpretations about the role and nature of 'nature' and human agency. Reactions to the project and its aims varied enormously but accounts of the project were almost always passionate, even deeply emotional. I often got a sense that as participants defended their own account of what is at stake in the HSRC's geoengineering experiment, they felt that they engaged with a deep sense of their own identity. Some participants within the case study expressed deep distress that the experiment had been carried out, or even conceived of at all. Indeed some were upset that the concept of geoengineering had gained sufficient academic traction to warrant social science research! Meanwhile at the other extreme, some participants within the case study described taking steps to implement and develop ocean fertilization strategies as a moral obligation, or even as a 'calling' (see Box 6.1).

Participant Noel Townsend: "*Sometimes it gets so bad I almost want to cry, because of what I'm feeling. The only way I can explain it is blowing the balloon up until it bursts. That's what I feel like. If I go too far sometimes I'm going to burst…*"
Kate Porter: "Do you mean this project makes you feel this way?"
Participant Noel Townsend: "*Yeah. It's so bizarre. We are killing the earth and trying to figure out how we can keep doing what we are doing. It doesn't make sense to me".*

"*There was one reporter… and I said 'obviously you understand the problems… you write about climate change problems'. I said, 'what are you going to say to your grandson when he says 'grandpa I know you understood all this, why didn't you try and do something about it'? You're going to say, 'well I was talking to a guy who was trying to do something about it, but I decided to make some money from my editor by writing this article instead'. I said, 'is that going to sit well with you?'... Everybody in the world is saying the same thing. We've got a major problem here and I think, I don't have the answer to it, but I have the keys to the first few steps down the path that we need to get on addressing"*

- Participant Raymond Wallace

Box 6.1

Through the extracts of interview responses offered in Box 6.1, it's possible to get a sense that at times participants within the case study offered what seemed like almost polarized accounts of the desirability and feasibility of the HSRC ocean fertilization project. This chapter will aim to shed some light on the breadth and fluency of these interpretations and to reflect some of this diversity in participant's motivations for supporting or resisting the HSRC. However there are some notable

threads of continuity in the ways in which participant's responses engaged with the research questions that first warrant brief reflection.

Chapter 5 (see section 5.6.4) offered examples of participants "dwelling" with the weather (c.f. Vannini et al., 2012) and illustrated how global scientific discourse about anthropogenic climate change often offered a discursive frame through which people made sense of weather and climate at a local level (c.f Jasanoff, 2010). While far from unanimous, this general awareness, and indeed frequent concern, about the idea of human-induced climate change penetrated the discourse widely, and 'climate emergency' framings (c.f. Corner et al., 2013; Nerlich & Jaspal, 2012) and 'political realism' framings (c.f. Corner et al., 2011) were common. Even when participants contested the reality of anthropogenic climate change, their knowledge of the principles was often quite striking and almost all participants sought to integrate and rationalize scientific concepts about climate change into their own meaning making of the 'geoengineering' ambitions of the HSRC (see Box 6.2). Such perspectives were often very nuanced and the case study context could have easily served as a research setting for solely exploring perceptions of climate change (c.f. Bravo, 2009; Norgaard, 2011; de Wit, 2015).

"*I think the Gaia effect says that we are past the point of no return… the earth is now giving in [to climate change]… You can see species moving North already… Because the organism of this earth… is already giving in and is already starting its release of its own carbon*"

– Participant Joanna Cook

Box 6.2

Although debate about the seriousness of anthropogenic climate change continued, through contestation about the desirability and feasibility of the 'geoengineering' ambitions of the HSRC, in a sense everyone within the study described fear for a future when nature was no longer able to sustain future generations physically, spiritually, and culturally (Box 6.3). In one form or another, participants seemed to almost unanimously express concern about the state, or health, of the natural world and to argue that the current relationship between humans and nature needs to be in some way improved. A feeling of human moral responsibility for nature and for repairing this human-nature relationship was commonly espoused (c.f. de Groot et al., 2011) and at times Haida oral history was drawn into these accounts. Further in expressing concern about the existing relationship between humans and the natural world, virtually all participants recognized some sort of intrinsic value to nature and expressed some kind of love and reverence for the concept of nature. In the words of Van den Born et al. (2001), a strong general "biophilia" or "nature friendliness" persisted.

"I want to give my kids the best opportunity they can have to have an experience like I did as a child… But I don't wanna yell and scream. Because yelling and screaming has done nothing. Carbon emissions just keep growing… Old Massett is like three meters above sea level. Who has the right and responsibility to act? They do"

- Participant Rob Peters

Box 6.3

Yet in many ways this was where participants' accounts diverged. In the discourse about the desirability and feasibility of the geoengineering activities of the HSRC, prescriptions for what the relationship between nature and humans *should* look like, accounts of what dynamics would signify success and explanations of how these goals could and should be realized varied enormously. Box 6.4 begins to illustrate some of these divergences.

"*A handful of Haida... [were] so arrogant as to assume that they understood the dominion, the area of which the Supernaturals have authority. And they overstepped their rights [and put] things off balance... So much so that they created the earthquake...*"

- Participant Joanna Cook

"*Conscious, measured manipulation of ecosystems is preferable as it requires an entity or individual to take responsibility... we need to better understand the natural system and learn to work with it for the betterment of all*"

- Participant Rob Peters

Box 6.4

6.2 Constructing the Role of Nature and Human Agency Through the 'Geoengineering' Activities of the HSRC

It is to unraveling some of these diverse commitments that this thesis now turns, as I seek to explore how diverse ontological, epistemological and axiological assumptions about the role and nature of 'nature' and human agency can be interpreted from the discourse about the desirability and feasibility of the 'geoengineering' activities of the HSRC. To explore the ways in which these related concepts of nature and human agency are constructed through discourse about the desirability and feasibility of the 'geoengineering' activities of the HSRC, in the section of this chapter that follows I will propose seven ways of framing the 'geoengineering' activities of the HSRC. These are frames that through my interrogation of the case study data, using the lens of Hedlund-de Witt's Integrative Worldviews Framework (see section 4.2.4.2), I have "encountered" in the interpretivist sense (Krøvel, 2015).

It is intended that the frames proposed within this chapter speak to the different ways in which participants and texts within the case study constructed the role and purpose of the HSRC's

'geoengineering' activities in relation to different ontological, epistemological and axiological assumptions about the role and nature of 'nature' and human agency. The frames are designed to help draw out some of the fundamentally different, perceived and preferred, roles, responsibilities and capabilities for human beings in relation to the natural world that shaped discourse on the HSRC. They construct different concepts of 'nature' and 'naturalness', afford different forms of nature value, and offer different knowledges of nature legitimacy.

The frames presented have emerged from grounded analytical strategies, and have been produced by hermeneutic engagement with the data and the construction of thematically resonant clusters of meaning. However in keeping with the informed grounded theory approach outlined in section 4.2.4.1, as Ereaut & Segnit (2006: 7) write "like all qualitative research, this interpretation inevitably engages not only the specific material being analyzed but the cumulative experience in cultural analysis of the researcher [herself]". As they continue, "in some cases this means that strands of discourse have been identified that are only just visible, but that are known by the researcher… to connect with cultural meanings expressed in many other fields".

As discussed in chapter 2 this is not the first time geoengineering social science research has directly explored the way in which 'human nature' may be interpreted through geoengineering discourse (Clingerman, 2014; Galarraga & Szerszynski, 2012). To the best of my knowledge this is however the first explicit empirical examination of the way in which human agency is constructed in geoengineering discourse. With this in mind, these framings of the HSRC's role and purpose are intended to serve a heuristic function in untangling the competing accounts of the human role in nature that were constructed by interview participants (and reinterpreted by the researcher) in their meaning-making about the 'geoengineering' activities of the HSRC. Each frame has been constructed through its own set of key words, metaphors, images, exemplars, storylines and emphases and reveals its own set of priorities, contestations and recommendations (c.f. Entman, 1993).

It is not however possible to fully disentangle these frames and they retain a certain 'messiness'. Within the discourse surveyed, many of the interpretative repertoires that contributed to each way of framing the HSRC's role and purpose were found to be deployed in support of, and in resistance to, the HSRC's ocean fertilization activities. Thus for each real or preferred role and function prescribed to the HSRC, there was contestation about the desirability and feasibility of that role. These frames therefore in no way uncomplicatedly delineate between those who supported or resisted the HSRC experiment. What's more, these frames are not mutually exclusive, but rather participants and texts combined and integrated their many elements. Boundaries between the frames also blur as the language and images deployed in each frame may overlap with the language

and images deployed in another. I do however suggest that in an archetypal sense these models of nature and of human responsibility and capacity endure across the corpus analyzed and that there is sufficient distinctiveness in each frame's interpretative repertoire to make it useful to propose these frames as distinct heuristics that draw out their unique features[126].

6.3 Framing Nature and Human Agency Through the HSRC

6.3.1 Mastering Nature and the HSRC

That geoengineering may be framed in terms of human 'mastery' of nature is familiar to social science research. Geoengineering has frequently been explicitly described as mastery, through such metaphors as that of a 'global thermostat' (Hulme, 2014) and of 'playing God' (Fleming, 2007; Hamilton, 2011b). A frame preoccupied with the desirability and feasibility of humans commanding nature at all levels, through the frame of 'mastery' geoengineering may represent the leveraging of human potential to overcome apparent natural limits and obstacles to human achievement. It may represent the inherent right and ability of humans to control and modify the natural environment to better serve their own needs and purpose. It may represent the fulfilment of humanity's obligation to gain control over natural systems to overcome environmental threats (Hulme, 2014).

In terms familiar to this frame, at times the geoengineering activities of the HSRC were constructed through both a linguistic repertoire of oppression, intrusion, invasion, colonization, and domination and, more positively, through that of conquest, control, command, empowerment, leverage, triumph, glory and ascendancy. "Playing God", an idea that has been deployed in the context of countless other technological developments (e.g. see Davies, 2006), was a widely used metaphor within the corpus of discourse explored. It was used to convey a sense that through ocean fertilization humans are attempting to override natural forces with human intentionality.

Within this case study I found some salience of this mastery frame among proponents of the HSRC's ocean fertilization experiment. HSRC affiliates commonly cast the geoengineering activities of the corporation as maximising the human potential and of being proactive in gaining control of humanity's dominant position in regards to nature. "We are introducing to the world practical applied ocean science and technologies that empower humankind to become stewards of the ocean pastures", HSRC former chief scientist Russ George wrote on his website (George, 2015). Participant Rob Peters meanwhile described his motivations for the project through the language of human vigor and aptitude. "*The green movement [is] all about… prohibiting man's ability to do anything. It's about prohibition. And this is another sort of thing about me personally. I'm more about 'you can'. Not about 'you can't'*" he explained. Albeit a little facetiously, Participant Russell Anderson also made sense of the geoengineering ambitions of ocean fertilization through the idea of enormous human capacity,

[126] As demanded by Cappella & Jamison's (1997) frame development criteria.

affording humans great competence and potential. "*If we actually focused our survival of civilization on something I bet we could have all sorts of sci-fi, geoengineering experiments. Failing that we just go and move to Mars and start geoengineering over there*".

At times HSRC proponents bordered on employing language and images that have traditionally been associated with ideas of dominion and ascendancy. For example demonstrating a clear shift in perceived agency, accounts such as those in Box 6.5 below suggested that through ocean fertilization humans may have the potential to fundamentally alter the state of the climate system and in the case of the paired salmon restoration goals, even perform 'an ocean miracle' and 'create life'.

"My work developing and teaching the practical skills and science of ocean pasture stewardship in partnership with a tiny native village on the islands of Haida Gwaii in the N.E. Pacific has demonstrated that an ocean miracle is near to hand, affordable, and deliverable"

(George, 2013b)

"*It's extraordinary when you think about it, the amount of life that was created and just in a small area*"

- Participant Jim Ross

Participant Martin Clarke: "*remember the first story, 'we created life where there wasn't'*" –
Participant Marianne Dunn: – "'*Where there was no life before*"'

"*In the interview on CBC when it first blew up, the quote was 'creating life where before there was none'. Biblical quote if I ever heard one*"

- Participant Russell Anderson

Box 6.5

Yet whilst these features of the discourse hold some interpretative salience with a mastery framing, in fact I actually had to look quite hard to identify these signalling features within the discourse of proponents of the HSRC. Reflecting a finding in Clingerman (2014), supporters of the geoengineering activities of the HSRC largely do not appear to be arguing for such forceful leverage over natural systems or reflecting a desire to replace 'natural' systems with 'superior', man-made systems. Indeed to an extent, virtually all participants appeared to reflect some sense of a perceived inherent value to the 'naturalness' of climate and ocean systems which, in different ways, they sought to reconcile with their position on ocean fertilization.

Instead, among proponents of the geoengineering goals of the HSRC's ocean fertilization project, any 'mastery' of nature was typically sought fairly reluctantly, accepted only as a means of overcoming the challenges presented by earlier human interventions into natural systems. In this sense proponents of the HSRC that employed a frame close to that of "Mastering Nature", reflected a position close to that argued by Mark Lynas (2012) in his book *The God Species*: Humans

are inflicting enormous harm on our planet and transgressing natural boundaries at enormous risk. Since we have already assumed a position of enormous influence over the planet and we are now equipped with the knowledge to manage natural systems to stay within these boundaries, we, 'the God species' have a responsibility to 'save the planet' (see also Clingerman, 2014).

In this sense then the mastery frame serves as a kind of strawman double hermeneutic (Giddens, 1987) that does not appear to meaningfully represent the position of most proponents of ocean fertilization within this case study. Yet employed widely among the HSRC's detractors and often used to support the construction of other frames (see for example the 'Preserving Nature and the HSRC' frame), the frame nevertheless serves as a powerful rhetorical device to help untangle some of the ways in which people within the case study constructed objections to ocean fertilization.

In most instances the 'mastery' frame was used to convey a sense of hubris: The notion that the geoengineering activities of the HSRC represent humanity lacking the proper humility and failing to appreciate their place within the larger order of life. This frame drew heavily on the rhetoric of 'colonization' and intrusion, as humans were described as seeking to establish themselves outside of their own territory and thus entering into realms where they don't belong. Those who espoused this frame often had a clear sense of whose territory was being intruded upon. Whether understood as God, Gaia, Mother Earth, supernatural beings or merely the integral force of Nature, this frame often drew upon the notion of an inherent natural order with its own internal logic and agency (c.f. Castree, 2005; Lovelock, 2008). For proponents of this frame, intervention into this order through ocean fertilization was often seen as *a priori* unacceptable, a symbol of perceived human superiority and out of step with the balance of nature (see Box 6.6).

"*They assume they are the best people on earth to run the ocean*"

- Participant Gary Bennett

"*It's invasive. It's stupid. I blame people trying to take the creators place. They are delusional*"

- Participant Marlene Hawkins

"*First Nations people have always had a connection to the weather and they have been profoundly affected by the weather. [When there were] droughts in the South West – you know how they thought to change the weather was rain dances and sun dances and different things. But to go from more spiritually wanting and asking for more, to actually physically doing something that will make it change, will change us… When you're asking and performing for weather you're not being in control. It's more of an asking thing and it connects you to the earth, so you're very much aware of the systems, rather than going about controlling and making change* "

- Participant Jane Clarke

"*They were playing God. They had no right to do it… If there is a God that's the only entity that has the ability or the right to impose their will on the planet*"

- Participant Isabel Todd

Box 6.6

In this frame, that humans had overstepped into the realms of the 'natural' was, often the very reason that humans sought to call on ocean fertilization in the first place. "*People have turned their back on God too much, that's why the world is in such a mess*" Participant Charlotte Elliott explained. Thus ocean fertilization represented an extension of the same process that 'got us into this mess in the first place'. "*There should never have come to a point where you need to do that. If they hadn't have done harm in the first place you wouldn't be scrambling now to stop the climate change*", Participant Marlene Hawkins explained (c.f. Whyte, 2012).

Participant Joanna Cook elaborated this point. "*All of these things* [the geoengineering proposals discussed during the interview] *are about human selfishness. We don't need any of this if people begin to behave as if they are a part of this great organism, this huge universe and this great cosmos. If we all began acting like that even poor people could eat… It's not recognising that we are a part of the huge cosmos*". Through this extract Participant Joanna Cook highlights another salient feature of the mastery frame: That the mastery resisted through this frame is often understood as a product of human greed and self-interest (see also Box 6.7).

"*I mean we're trying to control everything. I feel that human beings are the worst thing they put on this earth. We think that everything was put here for our convenience and that's not reality*"

- Participant Noel Townsend

"*I think it's just continuing somewhat of an arrogance that nature's here to serve us. That, you know, there's oil in the ground, get it all out because it's here just for us… That we have a dominant higher calling for it. I think it's arrogance. I think it's us out of step with nature. It somehow assumes that nature needs to serve us and make our lives easier, make our lives more comfortable*"

- Participant Kelly Baker

Box 6.7

Typically humans do not succeed in this frame. Instead this frame brings to the fore the fallibility of human action. The idea that scientific rationality furnishes humans with a powerful means of understanding and relating to the environment is not typically contested, however through this frame different forms of vernacular, cultural, spiritual, moral and experiential knowledge are given legitimacy and the limits of this knowledge are often stressed. Humans don't and can't understand the vast mysteries of the universe. Thus the quest for mastery is derived only from an unjustified confidence in human knowledge, power and capacity. Would-be 'Masters of Nature' are nothing shy of delusional (Box 6.8).

"*It all does come down to some degree about ego – that yeah we have control, we can fix things. Which is fantastically, basically untrue. We haven't been able to control anything yet*"

- Participant Valerie Collins

"*Now part of the problem is this bible that we have, where mankind has written that we shall have dominion over the earth. This business of dominion means that we are somehow of greater value, of greater intelligence, of greater knowledge, than the earth is of herself… to say that we didn't have nutrients in that area of the sea, have we studied? Do whales need to go through that place? Is there some reason they might have to go? What kind of things actually live in there that are contributing already that they don't know about?… If they are going through what apparently is a dead zone, there must be a reason… The mystery of the universe is gigantic and we have not spent enough time to get down to the bottom of it and the baseline of what's going on. So if we don't understand, if we block the sun, we don't understand all the elements, all the pieces of it. Only the sun understands that. There are too many elements involved for us to be muddling around. We don't know what the will is… The will of… the cosmos*"

- Participant Joanna Cook

Box 6.8

From attempting to 'master' nature, humans may face enormous risk to themselves and to all that they cherish. Yet consequences could result from more than just technical incompetence. Instead, signalled through personifying linguistic devices, natural or divine forces are often afforded active conscious agency. Reflecting findings in earlier social science research on perceptions of geoengineering (e.g. Corner et al., 2013; Macnaghten & Szerszynski, 2013), through this frame humans stand to face karmic retribution or even divine punishment for their hubristic sins against nature, God or other metaphysical forces (c.f. Hansen, 2006). As seen in Box 6.9 below, participants interpreted a number of geophysical phenomena that have occurred in Haida Gwaii since the ocean fertilization project, as evidence of nature 'biting back' at the HSRC's arrogance and presumption (c.f. Macnaghten & Szerszynski, 2013). Thus through this frame the geoengineering activities of the HSRC are set to become a tale of comeuppance, from which only humility and respect can incite salvation.

"*There are stories of famines. And those are things when, when we are disrespectful… The loss of hotsprings has been attributed to the supernaturals unhappiness with being so arrogant and so presumptuous as to believe that we are able to do something like that – what happened up there in Massett*"

- Participant Joanna Cook

"*We shouldn't try to be playing God… Somehow nature has it's own way of rebounding against whatever you do wrong. When we had that earthquake a couple of years ago you know I think that was an eye-opener to the iron dumping too… It scared a lot of people. A lot of people went 'holy smokes, that never happened like that before'. And people like myself I just point blankly thought the Gods are mad at us and decided to shake the world up as we did something wrong*"

- Participant Ricky White

"*God controls the weather and when he's unhappy with what people are doing we do have to suffer consequences. That's why they call things like that an act of God… God allows certain things to happen as a sign for people to wise up in their ways and everything. That's why I don't feel that people should start to play God and dump things in the ocean and… try to change the weather patterns because it always seems to backfire. Because they have no right to begin to play God… We've already had an unusually high amount of amnesic shellfish poisoning and red tide closures than we have in past years… One thing that I found really interesting, was that the tsunami happened on the very first day. When I came home from the meeting I handed my husband the information, the sites to check up on the iron fertilization thing. And I said I'll go turn on the TV and see if I missed anything while I was gone. And here flashing across the screen was huge earthquake hits Japan. I said oh my God it's a sign. Because what they're trying to do is to play God. It just seemed wrong to me, what they were doing*"

- Participant Charlotte Elliott

Box 6.9

6.3.2 Developing Nature and the HSRC

This frame is signalled by technological optimism that positions ocean fertilization within a long line of technological developments and innovations that have emerged in response to human and environmental challenges and that have facilitated the advancement of human society. In some ways the interpretative repertoire of this frame blurs into the 'mastery' framing – indeed it is this very 'development' framing that appears to be interpreted as 'mastery' by HSRC detractors. However those who frame the project in terms of 'development of natural systems', do not typically do so in terms of the hubris that characterizes the 'mastery' framing. Instead this frame makes sense of ocean fertilization through such ideas and promissory language as 'innovation', 'development', 'capacity', 'improvement', 'cultivation', 'harness', 'progress' and 'opportunity' (c.f. Porter & Hulme, 2013).

Providing barriers to development are removed (e.g. sufficient funding is directed towards research, regulation does not stifle innovation and the markets are left to perform their natural correcting role), under this frame the risks faced from climate change can be managed through technological innovation (see Box 6.10). And ocean fertilization may be the very 'technological fix' that humanity has been searching for.

"We can do all sorts of clever things and geoengineering is undeniably one of them… I think we're perfectly smart enough to heavily influence the weather. We could do any number of things. If there was like a natural phenomenon that started making the planet un-liveable I bet we'd have a good kick in the can at being smart enough to pull our shit together"

- Participant Russell Anderson

"*We are at a point now where we look and we say, okay, the lifestyle that we are living and what we are doing to the planet is not sustainable. How can we change that? I think if we put innovation to that, and money, I really do think that we can find better ways*"

- Participant Rob Peters

Box 6.10

Yet while innovation promises the essential solution to climate change (c.f. Gifford et al., 2011; Terwel et al., 2009), the frame is labelled 'developing nature' to reflect that this frame is essentially a call to recover optimism since, at times, through this frame environmental challenges like climate change become opportunities as much as problems requiring a 'fix'. Indeed, reflecting the Boserupian hypothesis that apparent planetary limits or constraints can be overcome by technology, ocean fertilization becomes associated with ideas of enhancing function and maximising efficiency. The idea of cultivation – whether of the ocean, of the atmosphere or of other planetary or human resources – is easily incorporated into this frame, as proponents discuss how through ocean fertilization ecological reactions and the earth's resources can be made to work more effectively and efficiently, to meet the burgeoning needs of humanity and allow life to flourish (c.f Hansen's, 2006 notion of nature as a 'challenge').

In terms familiar to scholarly discourse, through this frame proponents of geoengineering are in effect advocating consciously implementing the 'good' (Revkin, 2014) 'anthropocene' era (Crutzen, 2002a, 2002b; Steffen et al. 2011b), to actively create new and deliberate forms of nature-human hybrid. Or, in the words of Clingerman (2014: 11), to "humanize" natural systems, to make them work harder and better, and ultimately to make the world a fundamentally better place (c.f. Boyd et al., 2001) (see Box 6.11).

"Most of the ocean, and thus the earth, remains a desert. The development of open-sea mariculture could change this radically, creating vast new food resources for both humanity and wildlife… The advent of higher carbon-dioxide levels in the atmosphere has been a great boon for the terrestrial biosphere, accelerating the rate of growth of both wild and domestic plants and thereby expanding the food base supporting humans and land animals of every type. Ignoring this, the carbophobes point to the ocean instead, saying that increased levels of carbon dioxide not exploited by biology could lead to acidification. By making the currently barren oceans fertile, however, mariculture would transform this putative problem into an extraordinary opportunity"

(Zubrin, 2013)

"*It makes sense to protect that environment we're in, but you can actually make it better*"

- Participant Jim Ross

"*So what's happening is we put iron on the lettuces and they bloomed*"

- Participant Raymond Wallace

"*What makes me hesitate over the label [of being an 'environmentalist'] is I don't want to be associated with those people, right? Because I am not a screaming crying preservationist and conservationist… I read a lot of sci-fi… I really liked, especially the hardcore stuff and as you get into that it's all about how do we make this planet work for us and what are the ecosystem services*"

- Participant Rob Peters

Box 6.11

The development of natural systems through ocean fertilization is, in this frame, often described as part of a larger trajectory of human development and progress: A next step in human evolution and a continuation of humanity's evolving and maturing identity and relationship with the environment. In these terms the HSRC's ocean fertilization experiment is no different from the technological developments that have come before it and that have also been resisted in the early stages of their development trajectory (c.f. Macnaghten and Urry, 1998). As one article printed in the *Haida Gwaii Observer* noted of an interview with HSRC lawyer Jay Straith, "Mr. Straith likened Old Massett's cause to that of Galileo in the 17th century. At that time, Galileo was considered a heretic for proposing that the earth rotated around the sun" (King, 2013b). Participant Susan Hughes echoed a similar sentiment: "*It's just like a real new science and it seems when there's new science or medicine everybody is just like 'no, no, no'"*.

Journalist Robert Zubrin meanwhile similarly reflected such a position when writing about the HSRC in the American *National Review*. "There is a real irony here", he wrote. "The Haida are defending the human right to act as stewards of nature, while the warmists, who claim to be the elite of the most sophisticated society the world has ever seen, call for submission to the limits of the primitive earth. The Haida support scientific research to advance the human condition, while the allegedly cultured warmists superstitiously insist that such knowledge is to be shunned, and its practitioners suppressed. One must ask: Which side represents civilization?" (Zubrin, 2013). Whilst Zubrin's particular depiction is undoubtedly deeply paternalistic, resisting exploration of the

geoengineering potential of ocean fertilization was more widely construed through this frame as nothing less than a desire to restrict or ameliorate human 'progress', even a naïve form of 'primitivism'.

In the quest for human development nature is generally afforded a more materialist – anthropocentric – value orientation in this frame. However a powerful human justice dimension, according to principles such as equality, need and fairness, is also drawn in to this frame through this line of reasoning. Failure to explore the geoengineering potential of ocean fertilization would be to deny the quest for improved human wellbeing and the meeting of all human needs. Participant Rob Peters captured this perspective: "*If you have an idea whereby you can sequester carbon [and] you can enhance ecosystem productivity, to not do it, seems to me to be irresponsible… The obligation part, for me that comes in is to those people who again are the most affected by climate change, which is the poor, living in low lying areas who get most of their food from the land or the ocean… Look at our wicked awesome fancy lifestyle. Do we not owe it to them to at least try and see if it works on a reasonable scale?*".

Positioning the world as a product of our own making means this frame additionally projects a sense of self-responsibility for our collective trajectory (Box 6.12). As Mark Lynas (2011: 8) wrote in "The God Species", "Nature no longer runs the Earth. We do. It is our choice what happens here". It is thus prudent under this frame to actively define the terms of our evolving relationship – to ultimately improve the world. The greatest sin humans could commit in this frame would be to not explore the potential of ocean fertilization as an avenue through which to harness human potential for the greater good. Regulation must therefore not stifle this innovation.

"*When you push the button to go on SRM you say 'I know I am having this effect. I'm taking responsibility for this'… I think future generations would be, you know, if we could manipulate the climate I think they'd be angry if we didn't… I don't think what we are doing is world changing, but I do think it's a step in the direction that I would like to see us go as a planet, as a species, which is to be progressive, and open and responsible"*

- Participant Rob Peters

"*We [need to] take responsibility for it… We can't play the victims of something that's out of our hands… We can't really claim to be victims of any huge surprises"*

- Participant Russell Anderson

"*If you go down this path of opening this all up and you have the knowledge and the information and the understanding to realise there's this huge problem facing us and now you put together a possible solution, if you did nothing that would be kind of negligent wouldn't it? In fact legally that was a definition for that"*

- Participant Raymond Wallace

"*Our lives would be pretty mean spirited if a lot of these technological advances didn't in fact happen"*

- Participant Lewis Fletcher

"The ultimate question comes down to this: *Are humans creators or destroyers?* If it is accepted that we are simply agents of destruction, consuming or ruining resources that existed before we came, then it follows that human activities, numbers, and liberties must be severely constrained and that someone must be empowered to do the constraining. On the other hand, if it is understood that humanity is fundamentally a creative force, that we invent resources and improve the world — unleashing abundance, lighting the night, ridding continents of pestilence, and bringing barren oceans to life — then it becomes clear that the essential mission of government is not to limit liberty but to defend it at all costs. By advancing the case for humanity, the Haida have rendered us all a very important service".

(Zubrin, 2013, original emphasis)

Box 6.12

Confidence in the power of science, instrumental reason and the benevolence of technology, reflective of that which emerged from the philosophical traditions of the 17th and 18th century European Enlightenment, generally lies at the heart of this frame. For proponents instrumental reason typically knows no bounds, and through empiricism humans are able to accurately define problems and determine solutions (Box 6.13). It is through such confidence in their own application of scientific rationalism, that the HSRC was able to develop its own business development rationale based on the hypothesis that supplementing iron in the Pacific Ocean would ensure greater survival of juvenile salmon and facilitate the long-term sequestration of carbon into the deep ocean. As discussed in section 5.7.1.1, this same confidence allowed the HSRC to make a number of grand claims about ecosystem and carbon sequestration benefits that have and will result from their iron fertilization.

"*Now over 2 years later we seem to have found that our project worked. Not only did it increase offshore biomass, but also positively affected fish stocks with no discernable negative environmental impacts. The sequestration of carbon is in the process of being proved and as of now looks very likely to have happened and for a significant time scale... Our data is out there now and so look at it and ask questions, but don't pretend we did nothing and our team was anything other than a group of smart determined people working with the best instrumentation that man has invented*"

- Participant Raymond Wallace (personal communication)

Box 6.13

This intellectual confidence imbues proponents of this frame with the assumption that ocean fertilization may be both practical and controllable. Predictions from modeling and 'controlled' experiments are typically preferred research strategies. Yet this frame has developed around the assumption that even within field experiments, risk can be calculated, assessed in objective terms and managed. Through this frame proponents of the HSRC similarly expressed confidence in the ability of scientists to monitor the consequences of their experiment on the ocean environment (Box 6.14). In a sense in this frame the HSRC therefore parallel Galarraga & Szerszynski's (2012: 228-229) 'Climate Architect": "An idealized, imagined figure who knows in advance the form that they want the climate to take, who can identify the process whereby they can provoke the climate to take it, and who can carry out that process and bring the matter of climate into the desired form".

"*I have a faith that scientific models could help us. That we don't have to try on the ocean… I think we have enough science that we will, we can figure out totally what the impact is*"

- Participant Ruth Carter

"Doing what we did in an Eddy, which spins like a washing machine, you can watch it, you can see it [the plankton bloom]. You know what it's doing, you know where it's going. Which means a lot more control… It doesn't hurt to try something that seems measurable and calculated. It was a calculated risk… What went on was very controlled"

- Participant Jim Ross

"This is all about measurement and really the small scale of the project. If you compare this to the volcano… That was many tens of thousands of tons of natural dust that was spread on the ocean by natural process and not one negative side effect happened out of that"

- HSRC Director John Disney (in Smith, 2012)

"ETC… **Lied by saying** we would irreparably harm ocean eco systems, produce toxic tides and lifeless waters, worsen ocean acidification and increase global warming. *ALL FALSE and we have the proof in most intensive and extensive set of ocean data ever collected by anyone in Pacific Ocean plankton blooms. Further the Kasatochi volcano eruption of 2008… proved that restored ocean plankton blooms bring life back to our ocean"*

(OMVC, 2013, original emphases)

Box 6.14

At times the metaphor of the Earth as a 'machine' identified in earlier social science analysis of geoengineering discourse (Nerlich & Jaspal, 2012) also gained salience through this frame, as proponents appeared to attest a more techno-mechanistic view of natural systems, compatible with focus on single traits or functional attributes and the removal and substitution of parts, or widgets, within the system. "*It started to appear to me to be a very vast complex subject",* Participant Raymond Wallace explained for example. *"But when I just took time and thought about it quietly, if you break it in to its key components, then really each component is very understandable. So you know the plankton is disappearing why, because it's not getting the dust any more and it needs the iron in the dust (…). If you just follow the steps logically it all makes sense. I don't have to understand the complete plankton world to know that that is the root of the problem".*

While interpreted as a linear and "naïve" view of natural systems by dissenters (see for example the 'Preserving Nature and the HSRC' and the 'Conserving Nature and the HSRC' frames), through this more mechanistic account of nature, the role of scientists within the frame is also reflective of the "We are the Planetary Maintenance Engineers" viewpoint constructed in Cairns & Stirling's (2014: 31) Q-sort analysis. This role is premised on an understanding of science as omniscient and authoritative and *the* valid mode of understanding the world. Scientists are afforded an almost prophet like status through this frame and are the ultimate authority on ocean fertilization. Their diligence, dedication and honesty – ensuring the ever further reaching application of instrumental reason and the development of 'more and better data' – is the only barrier to 'liberating' nature's truths and 'revealing' "the path we must take" (Zubrin, 2013). Indeed 'science' metonymically stands for 'credibility', while other forms of knowledge are denigrated as 'irrational', 'unscientific' and thus 'illegitimate'. In this way this frame is powerfully internally validating. Since science speaks only truth, reflecting classic deficit model thinking, dissenting opinions and debate can be dismissed as arising from a lack of knowledge or an "alternative agenda" (Box 6.15).

"*The role of NGOs has been entirely negative. Short-sighted. There have been a lot of purposeful misinformation, and purposeful disinformation… I don't like people pushing their values… I'm just doing my work… Fact based decision making, that's where I am. That's exactly what I want. I'm a realist"*

- Participant Rob Peters

"*The calibre of the minds that I'm working with, and the people that are coming out of nowhere to help. Like Dr John Bird and that. If he's coming in to help because he's excited about it and saying this is what needs to have got done, then who am I as a laymen to say 'no this is a bad thing we did'? I can't think like that… But we've had crazy interviews with people who, and we'd explain all this, and then they'd go and write the other stuff. Because I guess it sold more papers or something"*

- Participant Raymond Wallace

Box 6.15

At times this frame was also seemingly associated with, or supported by, an image of nature closely recognisable as Buzz Holling's (1986) image of nature as 'perverse/tolerant', or even at times of nature as 'benign' (see section 3.4.2). Since by frequently advocating the permissibility of a more 'trial and error' approach to ocean fertilization, participants appeared to be expressing an understanding that natural systems are at least robust enough to ensure that human rigour and ingenuity may maintain planetary stability, such that disorder is minimised and reversible (Box 6.16). In this way this frame echoed the 'engineers and technicians' focus group in Macnaghten & Szerszynski's (2013) public consultation on solar radiation management, who favoured humans attempting to 'do something' to take anthropogenic climate change in hand, rather than just letting nature take it's course.

"*Trial and error. You never know until you do it… Do like a pilot project. Give it the old college try*"
- Participant Jack Larson

"*We've gotta start somewhere, that's the bottom line… people have to try it. I mean if it's failure, which I doubt… then try something else*"
- Participant Joseph Willis

"*Ocean fertilization I think it's totally fine doing limited experiments on that because we need to understand the theory and put it to the test. It seems highly reversible. Oceans are subject to far greater variation from volcanic activity. It only ever seems to improve things in a larger body like the Pacific… There's a lot of questions so lets just get answers for them*"
- Participant Russell Anderson

Box 6.16

6.3.3 Conserving Nature and the HSRC

This frame approaches ocean fertilization through the notion of 'pragmatism' and is concerned with the idea of making decisions about ocean fertilization that are 'sensible', 'practical' and work 'satisfactorily', to meet the needs of humans, including the human need for environmental protection. The conditions of the planet for humans is important to this frame. Thus reflecting the 'Developing Nature and the HSRC' frame, this frame is also resource oriented and it is open to the concept of ocean fertilization, should it prove able to facilitate 'wiser', more 'effective' use of the earth's resources. That's not to say however that participants constructing accounts of the HSRC project that resonate with this frame didn't also have a strong reverence for the natural environment and eschew a sense of responsibility to manage and conserve the natural environment for future generations. They certainly opposed its uncontrolled exploitation. Instead this frame gets it's name for its philosophical parallels to the conservation ethic of American conservationist Gifford Pinchot, who sought to reconcile conservation goals of nature with its many other values. The frame is therefore comfortable with the ideas of natural systems having multiple uses, of careful human management of natural systems, and of the sustainable use of resources.

Because nature is to be used and enjoyed, this frame does not get too bogged down in the ideas of 'pristine' nature that arise in the 'Preserving Nature and the HSRC' frame (see below), and intervention in natural systems is not 'wrong' per se. Indeed, reflecting the 'Developing Nature and the HSRC' frame and the thesis of conservation writer Emma Marris (2011), such notions are largely dismissed as 'romantic', 'irrational', 'naïve' and 'hypocritical (Box 6.17). Natural systems have never been independent of human influence (c.f. Macnaghten & Urry, 1998), thus agonizing over some arbitrary infringement of natural boundaries in the context of ocean fertilization is nonsensical and prevents us from asserting a more satisfactory definition of our role and from dealing with the 'practicalities' of climate change (c.f. Clingerman, 2014; Corner et al., 2013).

"*Every single resource on earth is under some sort of management scenario… left-wing, extreme environmentalists… always react… [they] take the position that any kind of geoengineering is wrong… [But] these guys run around in boats, using fossil fuels. They use rubber in cars. I mean they are all hypocrites right*"
- Participant Lewis Fletcher

"*Well… it's not natural, but then we've altered the climate so much that nothing's natural any more anyway*"
- Participant Isabel Todd

"*Actually I have defended it to people too saying first of all, 'you people in Victoria, speaking of uncontrolled experiments, how about your hundred million litres of sewage per day, that you're dumping'? Like you're telling me that's not an uncontrolled experiment with massive consequences?... Then some people go dump the equivalent of like, maybe a dump truck of you know, at worst fertilizer I guess… I mean it was just the outrage was so disproportionate to the actual harm*"
- Participant Russell Anderson

"*You're already monkeying around with the oceans. By turning on your light every day and getting up*"
- Participant Rob Peters

Box 6.17

Instead, open to the idea of 'rambunction' (Marris, 2011), this frame brings to the fore 'practical' questions of the 'effectiveness' and 'feasibility' of ocean fertilization. What matters to proponents of this frame is, 'does ocean fertilization work'? (See Box 6.18). Cutting greenhouse gas emissions should form the pillar of any strategy for tackling anthropogenic climate change since "*that's certainly the simplest thing to do*" (Participant Russell Anderson). But if geoengineering proposals such as ocean fertilization become 'workable' and 'logical', then they too should be embraced.

"*I guess it's a chicken and egg thing. If they can prove that it works then yes I think we should be stewards of the ocean"*

- Participant Russell Anderson

"*Of course any one of these [geoengineering proposals], if they work, could improve things. By improve I mean they will start minimizing the negative impacts, some of the adverse effects that we are trying to change from adverse to at least neutral"*

- Participant Lewis Fletcher

"*There are other factors that come that make it non realistic or more problematic in that regard… Cost would be a big one and it is unfortunate but that's the way the whole… But the general idea I think is interesting as far as adding iron and having it create an algae bloom, grabs the carbon, sequesters it and sends it to the ocean. I think that's a, that's a neat idea…if it can be proven… and very low cost which I think is the other thing that may be beneficial"*

- Participant Max Cannon

Box 6.18

Such a prescription hints at the typically inherently positivist undertones of this frame, as seen in the 'Developing Nature and the HSRC' frame. Those who constructed accounts of ocean fertilization that resonated with this frame often rushed to adopt a principle of neutrality, proposing evaluating the feasibility of ocean fertilization through cost-benefit analysis and quantifiable risk assessments. As with the 'Developing Nature and the HSRC' frame, in this frame decision making on ocean fertilization should be 'science-led', 'evidence-based' and 'objective' (Box 6.19).

"*On the actual geoengineering scale, we need to understand all of them [geoemgineering options] so that when we make a list and look at who's going to benefit, who's going to pay, and costs and risks and stuff, we can at least make a decision that's based on something*"

- Participant Russell Anderson

Box 6.19

Through the idea of ocean fertilization's 'practical consequences', this frame is defined by contestation about the perceived risks and benefits of ocean fertilization, as technological optimism and pessimism come head to head. The notion of 'efficacy' is key to this frame and in this way ocean fertilization gained credence under this frame for example through the idea that, as a carbon dioxide removal (CDR) technology, ocean fertilization is dealing with 'the route' of the problem - excessive greenhouse gas emissions in the atmosphere - as opposed to solar radiation management (SRM) strategies that just 'mask' the cause of the problem (Box 6.20).

"*The cooling stuff, SRM, all those thing that they're planning and that, it's almost like they're not, they are turning their back on nature. Almost this sort of like, 'okay well we've screwed nature up, now we've just got to try and get control of this a bit so we can make our earth more habitable', which is a bit of a stretch in my mind, because as I say I don't know how you sustain that… Once you've removed the carbon you've removed the carbon*"

- Participant Raymond Wallace

"*Solar radiation management, SRM, whatever it is, mirrors in space, blah-de-blah, are fine but none of them get rid of the bigger problem… the cause. With SRM you're treating the symptom. [Through ocean fertilization] you are treating the cause. End of story*"

- Participant Rob Peters

Box 6.20

Yet ocean fertilization was nevertheless approached cautiously and critically within this frame and risks and uncertainties were emphasized. Ocean fertilization advocates were often seen as overstating the human potential as the finitude of human knowledge and the complexity and interconnectedness of 'living' climate and ocean systems was stressed. Whilst science-lead decision-making was deemed preferable, the capacity of science to actually control and pre-empt the side effects of ocean fertilization and to assess the impact of any fertilization event was also contested. Concerns emerged about 'runaway impacts' and the opening up of 'Pandora's Box', the 'law of unintended consequences', the potential for 'lock-in' and the possibility that through ocean fertilization humans are just storing up problems for the future (c.f. Carr et al., 2012; Clingerman, 2014; Corner et al., 2013; Lovelock, 2008; Porter & Hulme, 2013, see Box 6.21).

"*I'm all for it. I'm all for legitimate exploring of true ways of getting… [But] I don't think you can use the living system and this is like the ocean fertilization thing. That's why I say I don't think it can ever be a true geological engineering fix, because it's too complex and you're still keeping the carbon within that living system right… Like it goes to the bottom of the ocean. In some places the bottom of the ocean is a very lively place that completely reactivates the carbon in different forms, potentially converts it to methane, which is possibly even more toxic, more greenhouse gas equivalence. The only thing, if there's a truly technological fix… truly capturing it out of the atmosphere, putting it into an aquifer, or down and then, you know, where you can kind of do a complete calculus. You know one for one. Capture carbon, it's now sealed in a concrete box somewhere. You know at least it's out of an active [system]… Even simple systems can't be predicted and yet you're trying to make this linear. You're trying to do something out in the ocean which has like, millions of variables"*

- Participant Martin Clarke

"*I think what's happening is people are academically focusing on very specific and very small sections of a very complex system… without actually knowing and without understanding any conceptions of what may or may not be triggered off of them. It's not even about will it work. What will happen once you over introduce any element that either didn't exist in a certain enclave, or exists and you're over-introducing it. So it's not even the triggers in that system, it's also what's going to happen 10, 20, 100 years down the road*"

- Participant Kelly Baker

Box 6.21

Reflecting a finding in Corner et al., (2013), to emphasize these concerns this frame often drew on the human history of overpromising the transformative potential of previous technological interventions, what Fortun (2005 in Yusoff, 2013) labelled "promissory technologies", and on the perceived failing of previous attempts to alter natural systems by introducing new elements. The introduction of non-native species was held as a particularly salient local example of how a "*cascade of impacts"* could arise from misguided interventions (Box 6.22).

> "*Haida Gwaii is a good example of human created problems where we have a vast number of introduced species on the islands here… Deer were introduced about 100 years ago… When it happened in the late 1800's I don't think anybody had a perception of what their action would actually end up doing in terms of how they would lose berry production, that the understory of the islands would be basically striped clean by the deer".*
>
> - Participant Ashley Turner
>
> *Box 6.22*

Similarly, the role that scientific models could play in mitigating these risks was debated under this frame, with participants expressing interest in the potential of scientific models to allow humans to progress safely 'a little at the time', "*so that we don't have to try on the ocean*" (Participant Lloyd Jones). As Participant Joanna Cook explained, under this frame modelling became a minimum standard in responsible innovation. *"Someone who was a conscientious scientist would not have done an experiment like this. Actually what someone would have done, I think they would have modeled it first… and then maybe done it on a very small scale… It needs to start in little labs, and really small little places".* Yet returning to the complexity of the ocean and climate system, participants constructing accounts of ocean fertilization that resonated with this frame were generally sceptical about the expected contribution of these models. *"Trouble is we can't do the math, it's too complicated",* Participant Lloyd Jones explained. In this frame the impacts of ocean fertilization were not anticipated to be knowable without full-scale deployment, if at all. Thus echoing the words of Macnaghten & Szerszynski, (2013: 465), under this frame participants were reluctant to live a "global social experiment".

Concerned about the possible side effects of ocean fertilization, this frame became a business of balancing the risks of ocean fertilization against the threat of unmitigated anthropogenic climate change. In the frame's rhetorical risk assessment, reminiscent of framings of geoengineering identified in media domains (Buck, 2013a; Nerlich & Jaspal, 2012; Porter & Hulme, 2013), 'climate emergency' and 'tipping point' metaphors gained huge salience. 'Political realism', the storyline of the failure of previous climate change mitigation efforts, supported these metaphors (c.f. Anshelm & Hansson, 2014; Buck, 2013a; Porter & Hulme, 2013). As did storylines about projected future emissions. "*We can't simply tread more lightly. Like the math doesn't work. There's too many people. Too much consumption. We haven't figured out other energy sources. At the very least there's going to be a whole bunch more*

carbon put up, starting now. So I think we're already in a management scenario" Participant Russell Anderson argued (see also Box 6.23).

"*It got to the point before, you know in the last sort of year, that we had to do this. We can't know what we've discovered and do nothing. You know and we were talking to the United Nations, we were talking to our own government and they were doing nothing… Realistically if we don't solve this in the next couple of hundred years then we're probably not going to make it"*

- Participant Raymond Wallace

"[Given that] climate change is the single biggest environmental threat, going forward all offers should be on the table"

- Participant Martin Clarke

"*The way things are right now, if we don't do something, it's just going to keep getting worse. Because they are not going to stop producing oil and gas. They are not going to stop burning coal, not until there's none left… So we have to do something"*

- Participant Rudy Cooper

"We are in a situation on this planet that things have deteriorated so much that now you have to start looking at things like this"

- HSRC Lawyer Jay Straith (in Smith 2012)

Box 6.23

A common expression of this frame was therefore the idea that whilst ocean fertilization may be inherently risky and objectionable, it may be the 'lesser evil' to unconstrained anthropogenic climate change and humans have 'nothing to lose' by attempting it (Box 6.24). This idea that ocean fertilization is a necessary 'Plan B', a 'last resort' solution to climate change, echoes Paul Crutzen's (2006) original framing of sulphate aerosol injection, and in each case this rhetoric is again powerfully internally validating. That ocean fertilization may be the 'only option to prevent a climate emergency' reflects Sikka's (2012) account of philosophical exceptionalism that authorizes the development of these geoengineering proposals, subsuming and excluding detractors and alternative perspectives (see also Gardiner, 2010; Whyte, 2012). "*[We have to] look at climate geoengineering because we have gone too far down this road to not. We don't have the luxury of saying you know we're against that* " Participant Raymond Wallace explained.

"*People are unsure whether to take the risk I guess, take a personal risk. But they've got nothing to risk. Like just look in front of you here. Climate change is right in front of us. Like right now we're dealing with how to protect our graveyeard from erosion. It's happening. The water is 20 feet away from our graveyard and that's meaningful right in our face… I'm not trying to be dramatic"*

- Participant Jim Ross

Box 6.24

Whilst notions of risk were generally founded on the desire for 'objective' evaluations of 'the best way to proceed', this frame typically maintained a strong social conscience that emphasized concerns about hegemony, global justice and democracy in ocean fertilization decision-making. A common extension of this frame was the idea that industry and private investment would be needed to drive ocean fertilization forwards. "*There needs to be a way to monetize eventually somewhere, somehow, because we are built on capitol"* Participant Rob Peters explained. But there were concerns that commercial entities tend to pursue their own interests to the detriment of environmentally and ethically 'optimal' solutions and that ocean fertilization may be misused (c.f. Macnaghten and Szerszynski, 2013) (Box 6.25). Strong government and regulation was therefore necessary as Participant Raymond Wallace explained, "i*n North America, we have industry dictating to government how you run this show and it should be the other way around. We need the governments in there for the regulation*".

"*Here in North America, this need to hold power over others and have more money and goods, that whole consumer mindset drives an awful lot of our decision making, rather than doing things for the greater social good"*
- Participant Ashley Turner

"*I am a technological person. I mean I am not interested in going back to the dark ages and so I think technology can often be a good thing. It's that humans don't know how to use it very effectively and so it gets carried away with itself… Technology is good. Technology is misused, both by human beings and by their governments. They are usually diverted to do things in ways that are not potentially good for the universe"*
- Participant Lewis Fletcher

Box 6.25

6.3.4 Restoring Nature and the HSRC

'Restoration' is a contested concept (Smith, 2013). That is not to imply that the labels afforded to the other frames in this study have any single, uncomplicated definition. Clearly they do not. But the idea of 'restoration' is nevertheless capable of mobilising a particularly diverse set of values and meanings and thus the linguistic repertoire of this frame is widely deployed alongside, and to support, the other frames described in this chapter. With this in mind, the Society for Ecological Restoration International's (SERI) definition of environmental restoration is useful to help clarify the particular focus of this frame. Restoration refers they say, to "*intentional activity* that initiates or accelerates the *recovery* of an ecosystem with respect to it's health, integrity and sustainability" (SERI, 2004: 1 in Smith, 2013, original emphasis). This frame is therefore defined through a linguistic repertoire of 'rehabilitation', 'recovery', and 'reparation'. It reflects on the geoengineering ambitions of the HSRC's ocean fertilization project for it's potential to help 'repair', 'replenish' and 'rebuild' the climate system, following deleterious anthropogenic impact (Box 6.26). Thus restoration is not about *withdrawing* human agency, it's about reshaping it in a way that has 'the natural' as its archetype.

"*'Geoengineering' is a word that needs dissection. In my mind driving your child to school in the morning in your car, even if it's a Smart Car, is geoengineering. What we did is 'reverse geoengineering'. We were trying to reverse some of the negative effects of man's actions*"

- Participant Raymond Wallace, Personal Communication

Box 6.26

Participants who constructed accounts of the HSRC project that broadly reflect this frame, therefore often made sense of the geoengineering ambitions of the HSRC's ocean fertilization project through a sense of nostalgia: A longing for an earlier, 'purer' climate, undisturbed and unthreatened by human activity. These storylines, and indeed the conditions for success, were defined by imagined baselines denoting what the state of the climate *should be*. These were often constructed around notions of earlier atmospheric greenhouse gas concentrations or average global temperatures, which were thought to define the 'natural' – 'pure' and 'right' – climate, before humans started interfering. Most commonly these boundaries were delineated by the idea of a 'preindustrial' climate. The carbon dioxide removal ambition of the HSRC was thus interesting to proponents of this frame for it's potential to help return the climate to this former, preferable state (Box 6.27).

"I *would like us to go back to a stage which was in the last million years, where we varied between 180 and 280 parts per million of CO2, which is when humanity evolved. Which is what we are most comfortable with… I'm coming from a place of fear. I fear that high carbon future. Maybe it will be good. It's going to be different. So I fear the change in some respects for sure"*

- Participant Rob Peters

"*I want humans to reverse the effects of their activities… [to] bring [the climate] back down into the range which generated the weather patterns that we're all were accustomed to in the twentieth century"*

- Participant Ashley Turner

"*My utopia would be sort of we need to get back to where we were whenever, a hundred years ago or whatever it was"*

- Participant Raymond Wallace

"*[We have to] try to fix it to the way it was before… before gas and oil and all the pollution that's being put out there now"*

- Participant Rudy Cooper

Box 6.27

For others the idea of aspiring to recreate a climate from a static moment in time was seen as arbitrary and illogical in the face of the dynamic, ever shifting nature of natural systems. "*I would love to protect and preserve and have a time machine and go back in time… but the simple fact is things… are going to change anyways. It has to change. Change is the only constant",* Participant Rob Peters elaborated. For these people this 'Restoration' frame became more a case of restoring an earlier *functionality* or *quality* to

the climate, that would repair the damage caused by human activity and allow the climate to 'resume it's own course'. To echo George Monbiot's (2013) account of restoration, here the goal was 'rewilding'. The climate may remain changeable, even volatile in this state, but it must be allowed to find its own way as there is an inherent value to this capriciousness. As Participant Kelly Baker explained, in this frame climate is awe-inspiring, intriguing and a source of surprise. "*It's kind of wondrous in the magnitude and the power behind it"* (c.f. Van Den Born et al., 2001). If ocean fertilization could offer a means to restoring some of this autonomy, then it could help return the climate to its former glory.

Regardless of the particular way in which the 'end goal' of restoration is defined, in contrast to the 'Preserving Nature and the HSRC' frame (see below), the 'Restoring Nature' frame affords humans active agency to consciously attempt to manufacture the climate restoration process. This agency is permissible provided that 'restoration' remains the goal of human intervention (Box 6.28). This frame denotes that human and natural systems are so intertwined and mutually dependent that 'wild' states only exist because of human management. Thus the interpretation of ocean fertilization under this frame resonates with the initial iteration of Aldo Leopold's 'Land Ethic', described in his early work in game management. Here he called on humans to assist natural systems to reach humanly managed equilibria, to restore natural orders that civilization had destroyed (Leopold, 1986[1933]).

"*Man wants to manage things and try to manage nature and the environment. That leaves me with a very uncomfortable feeling… Now what we've done is we've screwed a bunch of stuff up so now they want to manage it back to health, which is kind of a different thing… We need to come up with a management plan to bring that back to health again*"

\- Participant Raymond Wallace

"So now it's up to us, we must not delay. We can help Mother Nature get back into the game"

\- Lyrics to '40 Million Salmon Can't Be Wrong', (Wright, 2012)

Box 6.28

Echoing George Monbiot's more modern account of 'rewilding' natural systems, one of the ways in which this frame suggests humans may be able to restore the 'natural' dynamic interactions of the climate system through ocean fertilization, is through the idea of removing 'foreign' elements from the system and returning 'missing' elements. Thus in this interpretation of ocean fertilization, the HSRC's carbon dioxide removal ambitions can be likened to Monbiot's instruction that in ecosystem restoration we 'pull down fences' and 'block drainage ditches' (2013: 10). Similarly supplementing the 'iron-deficient' Pacific Ocean becomes an analogous action to the proposal to

reintroduce the wolf to the far North of Scotland. "*The facts behind ocean iron fertilization is that you are restoring something in the ocean that normally would be there"*, explained Participant Joe Newman[127].

"*Human beings have messed it up pretty good in the last hundred years. You know. And we've gotta try and help it heal"*

- Participant Rudy Coooper.

"*At first I was sceptical and I thought about it and you know, it's just like you and I are women, how are we without iron? That's the way I have to think about it because I was iron deficient all my life"*

- Participant Susan Hughes

Russ George: "It's almost like putting a teaspoon of our multivitamin iron mineral into a square kilometre of ocean, that's all the ocean needs to come back to health".

- HSRC Director Russ George (quoted in CBC, 2013)

Box 6.29

This frame therefore offers an optimistic assessment of humanity's ability to assist, or to expedite, the recovery of the climate system following anthropogenic interference and in this frame the climate system is often cast in the role of a patient (c.f. Buck, 2013a; Nerlich & Jaspal 2012) that, with prescription of the right remedy, can be healed and "*groomed back to health*" (Participant Raymond Wallace) (Box 6.29). Through this frame humans are therefore offered a route to redemption: The opportunity to 'grow up', to 'clean up' after themselves and to 'take responsibility' for their earlier childish recklessness (see also Box 6.30).

"Climate change may be the issue around which we start to grow up… I sort of see us as sort of children and we've gone through our teenage years and now we are at young adulthood and we have go ahhh, that was a bad idea… we acknowledge it. It was done, now lets look for solutions…"

- Participant Rob Peters

Box 6.30

6.3.5 Preserving Nature and the HSRC

At the heart of this frame is the idea, familiar to environmental philosophy and indeed to existing geoengineering social science research, that humans should seek to live in accordance with nature, and to preserve nature's honour and autonomy, rather than attempting to modify it for their own purpose (e.g. Heyward, 2013; Jamieson, 1996; Ipsos-MORI, 2010). Reflecting a finding in Corner et al. (2013: 944), this frame was used to signal an interpretation of climate change as a symptom of human society having become 'out of sync' with the natural order, and of ocean fertilization as reflecting society's unwillingness to forgo consumption and material desires, to restore harmony with these systems. In many ways the 'Preserving Nature and the HSRC' frame therefore represents

[127] The HSRC attributes an apparent decrease in iron-rich natural dust deposition in the Pacific Ocean to anthropogenic land-use and climate change (see section 5.3).

an antithesis of the 'Mastering Nature and the HSRC' frame, since it runs counter to the idea that humans have the right to radically alter nature. Indeed these frames often overlapped, appearing together within the discourse and deployed to support one other by participants.

"*There is nothing natural or green about dumping iron in the ocean*"
- Participant Jane Clarke

"*For me it's not natural*"
- Participant Ricky White

"*I've come to distrust anything that is manmade*"
- Participant Charlotte Elliott

"*We shouldn't mess with Mother Nature… Everything should be as natural as can be*"
- Participant Gary Bennett

"*You know you change things like that and you wont have a natural world*"
- Participant Marlene Hawkins

Box 6.31

Ideas of '(un)naturalness', particularly of preserving 'naturalness', were fundamental to this frame (see Box 6.31 above) as nature was held to have its own '*integrity*' (Participant Jan Fields), at risk of being damaged by inappropriate human 'intrusions' such as ocean fertilization. In many of these accounts the value of nature lay in it being as 'pristine', 'unmodified' and "independently directed" as possible (c.f. Carr et al., 2012: 176); "*Nature without human interference*" in the words of Participant Jan Fields. It was impossible to reconcile the climate remediation goals of ocean fertilization in these terms, since by "*adding something that didn't belong there*" (Participant Ricky White) and seeking to modify the climate system, humans risked only further 'poisoning' or 'corrupting' natural orders and boundaries (c.f. Corner et al., 2013; Clingerman, 2014; Davis & Macnaghten, 2010). This frame denotes that through ocean fertilization humanity is attempting to 'write their signature' on the ocean and climate systems (Leopold, 1989[1949]: 68) and thus the HSRC are portrayed as pursuing a 'manmade' 'artificial', 'fake', 'counterfeit' or 'synthetic' nature, contaminated by human intentionality (c.f. Carr et al., 2012; Elliot, 1997; Sandler, 2012b; Smith, 2013), (Box 6.32). In this frame, even if the HSRC were to realize their geoengineering goals, in a move taking humanity further towards the 'end' or 'death' of 'wild', 'unmodified' nature (McKibben, 2003[1989]; Merchant, 1990[1980]), the inherent value of these natural systems would have been corroded.

"*Well you see the natural world has its own integrity… Leave the world alone and it will manage itself very well. So for us to interfere with and manipulate the natural world causes it to lose its integrity in a way*"

- Participant Jan Fields

"If Mr. George's account of the mission is to believed… could it be that the orcas I saw [from the British Columbian coast] were on the way to the all-you-can-eat seafood buffet that had descended on Mr. George's bloom? The possibility… provides a glimpse into the disturbing repercussions of geoengineering: Once we start deliberately interfering with the earth's climate systems – whether by dimming the sun or fertilizing the seas – all natural events can begin to take on an unnatural tinge… A presence that felt like a miraculous gift suddenly feels sinister, as if all of nature were being manipulated behind the scenes."

(Klein, 2012)

Box 6.32

Importantly not all accounts of the HSRC project from which this frame was constructed were dependent upon such an apparent nature/human dualism. Instead, rather than construct humans as inherently 'unnatural beings' (c.f. Clingerman, 2014), a different perspective emphasized nature and society as profoundly inter-reliant, and physically, spiritually and culturally connected. Through such accounts conceptual boundaries between the 'natural' and the 'social' became less stark (c.f. Smith, 2013) and humanity was left theoretically capable of assuming a position of 'oneness with nature' (Bragg et al., 1996).

Such a perspective emerged particularly among Haida participants, who drew on their own oral history of kinship with the land, and the interdependence of human and natural worlds (see section 5.6.1). However in this frame ocean fertilization was not considered to be "*relating to nature. They are doing something foreign so that they don't have to deal with nature… so that we don't have to worry about the trees and plants and oceans and you know, the real lungs and heart of the planet*", Participant Gary Bennett explained. Thus these participants still stressed the idea that for humans to wish to pursue schemes like ocean fertilization that "*interfere with these precious things, the earth, the environment, the ocean and everything"* (Participant Marlene Hawkins), they have lost touch with their connection to nature and have overstepped their rightful place within the natural order (Box 6.33). In this frame ocean fertilization therefore remains inherently 'unnatural'.

"*I think because of some of our talents as a species, we have lost our connections to the environment that we live in… for us to even think that we can control it, that changes profoundly the relationship… I think a lot of people would have some spiritual crises in a lot of different ways… There is a lot of work that talks about, nature deficiencies, that refers to basically nature deficiencies and people who live in urban settings and what that gives to them emotionally and mentally and in their health system. I think that that would have a very dramatic and very deterious effect upon us that I couldn't even guess*"

– Participant Kelly Baker

"Our job is just to take care of what we've got here you know. You don't exploit it. You don't take too much. You don't try to change the climate… They had the same teachings too at one time. Everybody did. But in England you guys, and other places like the States, they burnt up their witches, as they were called, the people that knew these things. That's why it's such a lost bunch of people on this earth today. They've got no sense of family. They've got no sense of clan. No sense of belonging anywhere. So what do you start doing? You start messing around with the atmosphere because you haven't got fulfilled inside of you. You know spirits not fulfilled. So they are desperately trying to fulfil themselves by trying to control things and that's not the answer. I don't believe it is"

- Participant Marlene Hawkins

Box 6.33

As seen in Box 6.33 above, through the desire to 'preserve' the integrity of natural systems, this frame often emphasizes intrinsic spiritual, cultural and emotional values to the natural world. Reflecting the philosophical writings of Scottish preservationist John Muir (White, 2006), in this frame non-human entities and systems should be preserved unimpaired for their own sake, regardless of whether they are useful to humans. As Participant Valerie Collins explains, "*there is no hierarchy. No one, human or non-human, is more important. Everyone and everything is equal*". Under this frame ocean fertilization is incompatible with these values, since it does not allow nature the opportunity to prosper and grow on its own terms. Proponents of this frame often further resist ocean fertilization as a product of a materialist value orientation; the extended use of market mechanisms at the expense of environmental protection and the perpetuation of the very resource-exhausting greed and inequality of capitalism that caused the current environmental crisis (c.f. Szerszynski et al., 2013). "*This is just a big excuse",* Participant Joanna Cook explained. *"A big way to make money for corporations and for human beings to be let off the hook for what's going on here. You know I'd prefer to burn up knowing that I did my best and worked my hardest… to be here and to be part of it… It's such a privilege to be part of this huge universe".*

"*It still gets back to arrogance. We still think the earth was put on. I mean we're killing it and now we're trying to figure out how to… reflect the sun, because of what we are doing. I find that so bizarre you know. Instead of finding solutions on how we can change so we don't have to depend on fossil fuels, we're changing the environment, changing the weather*"

- Participant Noel Townsend

"*Carbon credits are the stupidest thing ever invented. Yet another way for governments to avoid responsibility*"

- Participant Lewis Fletcher

Box 6.34

As seen in Box 6.34, under this frame ocean fertilization represents an attempt to eschew responsibility for realigning social systems with the natural order and thus this frame echoes earlier ethical anxieties about the 'moral hazard' of geoengineering (e.g. Hamilton, 2011b). "*I would fear that if these things worked then it would just give bigger corporations more excuses to pollute",* explained Participant Brent Morton: A situation that is, in the words of Participant Kelly Baker, "*missing the point*". Rather than looking for a 'get out of jail free card' (c.f. Porter & Hulme, 2013), the appropriate response to climate change under this frame is therefore to look at its structural causes and for humans to preserve what remains of natural systems by assuming their correct place within the larger natural order. We need to *"make people return to the fact that they are only part of the earth and to recognise that every single thing that you get came from the earth… We're going back and saying, we're part of this big organism, we are part of this huge cosmos. We are not greater… [and we need to work] in union with all things that are of this Earth",* Participant Joanna Cook described. Realigning with the natural order thus becomes the way to purify society.

Through this frame participants offered varying interpretations of how such "reunificiation" (in the words of Taylor, 1989: 384), could be achieved. But the defining feature of this frame – and indeed where the frame gained its title – was the persistent call for humans to preserve the remaining 'naturalness' of climate and ocean systems by exercising restraint and withdrawing 'inappropriate' human influence and agency. Echoing the famous *Jurassic Park: The Lost World* allegory – "these creatures require our absence to survive, not our help and if we can only step aside and trust in nature, life will find a way" (Friedman, 2006: 150) – this frame often cast humans as a largely destructive force in need of restraint (c.f. Clingerman, 2014). "We cannot go on trying to rationalize our unwillingness to confront our primary role in creating the global eco-crisis and to delay restraining the only species we can manipulate – ourselves", David Suzuki (2012) wrote of the HSRC project.

Instead of seeking to intervene in, or actively manage natural systems, this frame tells us that humans must remove their impact on the system as far as possible since nature does best on it's own and it should be left to "*do its own thing*" (Participant Ricky White) (see Box 6.35). "*There's nothing we could do as human beings to rectify it, other than stop destroying and trying to reverse it ourselves",* Participant Marlene Hawkins explained, emphasizing the inherent conflict between the 'Preserving Nature and the HSRC' frame and the 'Restoring Nature and the HSRC' frame. Participant Ashley Turner meanwhile rehearsed the notion that nature would eventually restore order if left to its own devices: "*Ecosystems of the world… have the capacity to bring themselves back into an equilibrium… It's never gone until you make the decision to totally cap it with some artificial material that prevents the environment from growing itself back*".

"We should be not eliminating but certainly lowering our footprint on the global environment is something we as stewards should be striving, if we are truly stewards of the global environment"

- Participant Ashley Turner

"*Just stop trying to change things and as far as management, it should be hands-off management. Sit back, see what the earth does… and just leave it alone*"

- Participant Gary Bennett

"*Let Nature take its course"*

- Participant Chris Shaw

"*We shouldn't have to alter the climate. All we should have to do is take a few steps back in time and quit doing the shit that we're doing to it*"

- Participant Harry Doyle

Box 6.35

By insisting that natural systems stand their best chance at survival through the withdrawal of human influence and agency, advocates of this frame often implied that natural systems are self-adjusting and dynamic, or even that they have their own internal logic[128]. By interfering with this system through ocean fertilization there is a risk "*that we interfere with whatever the proper cycle of the earth is" (*Participant Kelly Baker). Whereas if left to its own devices, *"the natural world can get along quite well without us"* (Participant Jan Fields). Such an account again incites a much more limited role for science and technology, which was often supported by depictions of the natural world as interconnected and incomprehensibly complex[129]. Thus in this frame scientific enquiry is commonly held to be too narrow and specialized as to be able to account for the whole natural system (c.f. Kawagley et al., 1998, see Box 6.36).

"*You can't do something without there being a cost somewhere… Because everything is interconnected. You can't make one change here and not expect it to be not changed somewhere else. You know, it's not like it's working in a vacuum"*

- Participant Jane Clarke

"*If you believe the world is linear and technology can "fix it," then you'll tend to believe geoengineering will work. If you believe the world is relational and everything is connected, you'll tend to believe that geoengineering is a stupid idea that won't work and avoids the real, much harder problem of reducing greenhouse gas emissions and creating a post-oil post-industrial society and economy, which in turn involves changing existing power structures*"

- Participant Valerie Collins

Box 6.36

[128] As Participant Ronnie Stevenson explains, "*I know there are some experiments going on, seeding clouds... [But] we're much better off to live with what we have… maybe we don't like [the rain] for a particular day, but when it comes it ripens the berries*".

[129] "*Things are connected… there is triggers and reactions… that I think we as humans don't always register*" (Participant Kelly Baker).

A common extension of this rationale, was the assumption that nature is delicately and precariously balanced and thus vulnerable to human 'meddling'. "*Observing the natural world with all of its variables, parameters, interconnectedness - with our impacts often unpredictable - one sees balance as precarious. Understanding the wisdom in the scientific method does not compromise our guiding principles. We must watch our steps, 'The world is as sharp as the edge of a knife'*[130]*"*, SGaana Jaad April White wrote powerfully at the end of a written submission to Old Massett Band Council[131]. Since slight shifts could cause irreparable damage[132], this frame puts humanity into a very cautious relationship with nature. "*[The HSRC experiment] was not precautionary"*, Participant Joanna Cook explained. Instead it served as a risky distraction from the opportunity to transform energy and economic systems to conform with more 'natural' ways in which humans could respond to climate change (c.f. Corner et al., 2013). The value of natural systems cannot be preserved through ocean fertilization. Instead, in this frame austerity and moderation will bring fulfillment. Humanity mustn't 'take more than nature can provide' and must seek behavioural choices that have a low impact on the environment.

6.3.6 Working with Nature and the HSRC

'Working with Nature and the HSRC' was a frame used to explore the extent to which the geoengineering ambitions of the HSRC's ocean fertilization experiment 'aligned' with 'natural' processes. At times ideas about inherent natural orders and about preserving nature's integrity, seen in the 'Preserving Nature and the HSRC' and the 'Restoring Nature and the HSRC' frames, played in to this frame. Further, echoing the 'Conserving Nature and the HSRC' frame, the desire to respond to anthropogenic climate change by 'working with natural systems' was at times employed as a pragmatic principle, based on ideas about the efficacy and potential of natural systems. The 'Working with Nature and the HSRC' frame is nevertheless distinguishable from the other frames proposed in this research in that it explores the extent to which ocean fertilization supports, works within, emulates or reproduces these natural orders (Box 6.37).

> "*You know the plankton bloom that we engendered or created, was created because of the iron that went into the ocean. We didn't put the actual plankton in the ocean. It's just what always grows when iron gets there*"
>
> - Participant Joe Newman
>
> *Box 6.37*

In this way advocates of the HSRC project, whose discourse lead to the construction of the 'Working with Nature and the HSRC' frame, reflect a storyline identified by Anshelm & Hansson in their study of geoengineering advocacy discourse which presents geoengineering as "Just

[130] A Haida proverb (CHN, 2007: 4).
[131] Quoted with author's permission.
[132] As Participant Valerie Collins explained. "*Systems don't gradually change. They reach a critical threshold, then shift – and you can't get back to where it was before. You can't get a raw egg back once you've broken the shell and scrambled it*".

Mimicking Nature" (Anshelm & Hansson, 2014: 113). "'*Geoengineering' suggests that we were putting another untried man-made scheme out there to try and mitigate the last 200 years of negative schemes, when in reality we simply mimicked nature*" Participant Raymond Wallace explained.

> "We looked around to see what nature does, and the big example that hits you between the eyes was the Kasatochi volcano eruption in 2008… [It] blanketed the whole of Alaska with dust which contains the iron nutrient, and almost the worst run ever predicted for the Fraser River turned into the biggest run almost in history in 2010. There is a direct link between those two and there has been scientific papers written about it by some of Canada's top oceanographers. And that was sort of like the icing on the cake, and we thought we have to take this a step further… There have been other iron dust events in the world, off Eastern Australia that did the same thing, caused big plankton blooms"
>
> - HSRC Director John Disney (in Smith, 2012).
>
> *Box 6.38*

The idea that ocean fertilization has natural analogues is at the heart of this frame. Participants often made sense of the HSRC's ocean fertilization project through a storyline which proposed the HSRC's iron fertilization efforts imitated the Kasatochi volcano, the iron-rich ash plumes of which were credited with the production of large phytoplankton blooms in the subarctic North Pacific in the autumn of 2008 (Box 6.38, see also section 5.3). The frame was also often combined with discourse reflective of the 'Restoring Nature and the HSRC' frame, as the idea that ocean fertilization was merely returning 'missing' elements to the ocean system was deployed to support the natural analogue storyline (Box 6.39)[133].

> "What I want to make very clear is that we do not consider micronutrient replenishment, of a naturally occurring substance, to be pollution. We are using this for restoration purposes"
>
> - HSRC Director John Disney, (in Smith, 2012)
>
> *Box 6.39*

This frame favours "*following nature's examples*" (Participant Tom Dawson), since it is assumed that this is both a safer and a more effective way to proceed. "*The big forces in the world are natural ones. Get them on your side with this and that's a much better solution that spraying aerosols into the air"* Participant Raymond Wallace explained. Using this frame ocean fertilization was frequently described as a 'soft technology' approach; pleasanter, gentler and more manageable (c.f. Greenhalgh, 1988). "*It seems as far as technology goes it's low technology, like get iron and dump it off the boat. I'm sure it's more than that, but really when you look at some of these other ones [geoengineering proposals] and the machines they have to do or the technology that they need to march trillions of small mirrors into space… As far as adding iron and having it create*

[133] This storyline is premised on the HSRC's attribution of an apparent decrease in iron-rich natural dust deposition in the Pacific Ocean to anthropogenic land-use and climate change (see section 5.3).

an algae bloom, grabs the carbon, sequesters it and sends it to the ocean I think that's a neat idea", Participant Max Cannon described. The idea that ocean fertilization was "*following more of a natural system*" (Participant Jane Clarke) and "*working with nature, rather than against it*" (Participant Tom Dawson) additionally helped to quell concerns that humans were overstepping their rightful place within the natural order (c.f. Corner et al., 2013).

"*The idea of cloud brightening seems interesting because… it seems like it would be relatively benign. If you are just sending sea water into the atmosphere… it seems like it would be benign if not successful"*

- Participant Max Cannon

"*But to say the risks are huge, well explain to me why nature did it? I think nature's worked out the risks. It probably took a few hundred million years, but what we got left is the results of doing this on a huge scale. Look at the South Pacific. I mean I can't remember the number, it's just nuts, hey. Like 20 million tons of dust a year going to that ocean… That tells me that the risks have been figured out by nature"*

- Participant Raymond Wallace

Box 6.40

Perhaps most strikingly however this frame again plays on a sense of natural systems as inherently logical (c.f. 'Preserving Nature and the HSRC' frame) and serves to dispel the notion of risk in ocean fertilization experiments. This frame contends that if geoengineering ideas are based on the same processes that nature used before humans existed, then it is nonsensical to think that they may be hazardous. Reflecting the storyline described in Anshelm & Hansson (2014) in this frame, ocean fertilization has been 'tested by nature'. Nature has worked out the risks of ocean fertilization and shown humans the path they should take. We must work with this example the frame denotes, since as Anshelm & Hansson (2014: 114) suggest of this logic, afterall, "if we cannot trust nature, what or who can we trust?" (Box 6.40).

"*Some of [the geoengineering proposals] seem fairly impractical… Putting something up in the sky, like putting things in the air to reflect or to form clouds… using sort of a natural system… as opposed to literally putting mirrors up in the air, [this] seems more practical. Just like when volcanoes spew out their ash then it's going to cool down because of that ash being in the atmosphere. So it feels like it's following more of a natural system by putting something up there. And it can come out, maybe it's going to cause acid rain or cause different things, but it's not going to be mirrors up there*"

- Participant Jane Clarke

Box 6.41

Some earlier research has suggested that 'encapsulated' geoengineering technologies, such as air capture or space reflectors may be ethically preferable to unencapsulated geoengineering proposals such as ocean fertilization and sulphate aerosol injection, since they do not involve releasing 'foreign' material into the wider environment and thus may be seen as 'non-polluting' (Bracmont et al., 2011; Cairns & Stirling, 2014; Hulme, 2014; Royal Society, 2009). Yet this frame largely throws

this logic on it's head, favouring unencapsulated technologies, which are held to work with and harness existing natural processes and systems (Box 6.41). Geoengineering proposals that do not 'work with natural processes' or 'mimic nature' meanwhile are typically dismissed in this frame as nonsensical or foolish (Box 6.42).

"*The one that really kills me is the fake trees. Like fuck just plant a real one! It's just, that's so easy. These fake trees, you need to get 400 bucks a ton or 500 bucks a ton of carbon to make these things useful. And they are using metal that you've gotta mine out of the ground. They are using sulphuric acid. I mean. Just stop it. Plant a frickin tree*"

- Participant Rob Peters

"*There was a lady in Arizona who suggested – This was in this crazy book I read – She wanted to cover the whole Southern States with white plastic to reflect the sun. And I'm thinking, you actually thought this was a good solution. But she's giving – She was presenting this at a conference. That's crazy. I mean you (…) pollution to manufacture all that plastic. You don't think that's going to make, you know – That's not mimicking nature*"

- Participant Raymond Wallace

Box 6.42

This frame does not differentiate between something that happens 'naturally' in nature and something that humans bring about through their own deliberate agency, thus a common extension of this frame is the idea that humans are a *part* of nature, and as such can act within it (c.f. Clingerman, 2014). "*We are just a part of the system*", Participant Rob Peters explained. "*Our manipulations of the system will change it… But what is nature?... We are inseparable from that*" (see Box 6.43).

"*It's like saying if you have a baby and the baby is turning blue after birth and you give it oxygen, because it can't breathe properly, then you're giving it a toxin. You're putting something into it that should be in there. But sometimes babies can't breathe properly when they are born, so you help them out, put some oxygen in there. It should normally be there… So adding iron to the ocean… it is factually correct that the iron normally would be there in the ocean. Due to climate change global warming and the side-effects of anthropogenic CO2 increase, iron is lacking in the high-nutrient, low-chlorophyll zones of the ocean. Replacing it is a completely organic thing to do that humans as part of nature can engage in*"

- Participant Joe Newman

Box 6.43

This frame therefore also often played on a sense of kinship with the Earth that denied categorical separations between society and nature as well as the perceived superiority of the human. Instead the earth and the human were often linked through the belief that one cannot exist without the other. Through such reasoning in this frame ocean fertilization was often described as 'giving back' (Box 6.44 see also section 5.6.1.1).

"*The way I think of this [ocean fertilization] is that in Haida Gwaii when we clean our fish, we put back in the ocean… It's nourishment for all the other critters that are out there. They feed on it and it just keeps the cycle going… DFO doesn't want us doing that anymore… to me that's really crazy. Now I… use it for fertilizer for the garden, so it's fertilizing the ground but it's not fertilizing the ocean… So with this iron thing, I just think that we all have to try something, in our own way, or through groups or whatever, to help old Mother Earth. I mean we've been abusing her for so long*"

- Participant Rudy Cooper

Box 6.44

It was through this frame that the HSRC particularly sought to align its project with the Haida identity, especially with the Haida teaching of reciprocity (Box 6.45, see also section 5.7.4.1). "Reciprocity reflects the relational worldview and the understanding that we must honour our relationships with other life", Hart (2010: 7) explains. However notably very few Haida participants constructed accounts of the project that resonated with this frame.

"As the people of Old Massett who have long sought to live in harmony with land and sea a simple truth has become apparent. We must rekindle our stewardship of our ocean pastures; it is a cultural, spiritual, and practical imperative. The Haida people and culture would never have flourished as it has for millennia without the relationship we have with the salmon and the sea. Modern science is helping show us the path we must take"

(HSRC, 2013a)

"To accomplish great things, we must not only act, but also dream, not only plan, but also believe. We are working to achieve a state of wisdom in, with, and on behalf of the natural world and all its inhabitants… plants, animals, people, and those mythical spiritual in-betweens like "Salmon Boy"

(HSRC, 2013b)

"Much of the credit for this miracle belongs to one tiny village of fewer than 800 souls. One village of people with a real belief that they are part of nature. And along with that faith, as a village we have proven to have the ability to dream the impossible dream and to work to make that dream literally come alive… If just 99 more villages join with us, we will bring village fish back everywhere, as food for our children, as our gift to all life in our Mother Ocean, and as our labour of love on behalf of the rest of the world. In doing so together as 100 villages we will eliminate the lions share of the dire consequences of fossil CO2. Far more than the Kyoto agreement ever hoped to do"

- A Call to 100 Villages (George, 2013b)

Box 6.45

6.3.7 Living with Nature and the HSRC

This frame is defined by a particularly fatalistic conception of nature, which sees nature as all-powerful, fundamentally self-determined and often unpredictable. Imbued with a linguistic repertoire that denotes submitting, surrendering, conceding, accepting and adapting to the power of natural forces, the idea that the conditions of Earth are outside of human control is at the heart of

the '*Living with Nature*' frame, making this frame ostensibly another almost dichotomous variant to the '*Mastering Nature'* frame.

A rationale elucidated through the reflections of Participant Ashley Turner who argued that ocean fertilization requires "*accepting that humans and their enterprises do have the ability to impact the world around them"*, it is perhaps unsurprising that this frame emerged from interactions with participants who generallly expressed resistance to the geoengineering activities of the HSRC. Through this frame natural systems and forces like climate were described as being too vast and great for humans to meaningfully influence through ocean fertilization. "*There is more energy and power there than you can effect"* Participant Ronnie Stevenson explained. While through similar discursive logic Participant Ricky White described the idea that ocean fertilization may affect climate as nothing more than a "*pipe dream"* (Box 6.46).

"*I don't think it [ocean fertilization] changes it [our relationship with nature] in any significant way. It's kind of a teaspoon in a bathtub sort of thing… or a swimming pool or something*"

- Participant Ronnie Stevenson

"*We can't change it. The weather is too global… See this tiny period right here on the 'i', that's the effect of the so-called iron fertilization of the Pacific Ocean right here. How could this influence the weather? It's the same with all these other [geoengineering] proposals… they would be the same scale as this, the tiny dot. We're talking global… I don't see how any of these ideas would even come close to working*"

- Participant Marco Richardson

Box 6.46

This frame does not actively engage with debates about 'managing' climate through geoengineering, since it deems these natural systems to be fundamentally *un*manageable. Still, under this frame natural systems are not necessarily a lottery in the 'capricious', sense (c.f. Holling, 1986), since at times again participants again afforded the all-powerful force of nature its own internal logic. As Participant Ricky White described "*We're always playing with nature, trying to interfere with nature, trying to add something to nature, when nature has it's own way of cleansing and feeding what needs to be fed… Everything has it's own way of surviving… Then nature just wants to put it back the way it was… and nature goes in there and shows more force than anything… So to me that's how I believe in Mother Nature is more stronger than humans and anything that humans build*". Thus while secular versions of this frame merely emphasized the trivial nature of human power in the face of natural forces, ideas of divine agency penetrated some of these depictions and at times this framing became interwoven with concerns about hubris and divine punishment (c.f. the 'Mastering Nature' frame).

This frame's distinguishing feature however lay in the way that it deviates somewhat from the finding of Corner et al. (2013: 945) who, within their deliberative focus groups exploring public

perceptions of geoengineering in the UK, found that "there was almost universal acknowledgement that geoengineering meant that natural systems would be interfered with". Instead under this frame, precluding divine retribution, the geoengineering ambitions of the HSRC were constructed as fairly benign, even irrelevant, simply "a *waste of energy and time*" (Participant Ronnie Stevenson), as nature will take its own course regardless of human action.

By casting ocean fertilization as a 'thing so large and fantastic that it cannot be true' (c.f. Ereaut & Segnit, 2006: 14), this frame echoes the 'Settlerdom' climate change linguistic repertoire proposed by Ereaut & Segnit (2006: 14) that amounts to the denigration of climate change as 'outside of common sense'. Indeed by positioning natural (i.e. non-human) forces as the principal, or even sole, determinants of the condition of natural systems, the very idea of anthropogenic climate change was challenged through this frame (Box 6.47).

> "*Nowadays it's the so-called global warming. Which to me is not a belief that I believe in. I believe it's just a cycle that happened a couple of thousand years ago and it's just coming back to what it was back then… You know we've always seen weather changes… we just have to live with it… When the storm blows we hold on to our seats and just hope your roof don't blow off… Let Nature do its own thing*"
>
> - Participant Ricky White
>
> *Box 6.47*

This frame was not particularly prevalent among the discourse of research participants. Only a few participants constructed an account of the HSRC project that resembled anything very close to this frame. Yet it is particularly worth noting that this frame did emerge from my engagement with the case study discourse, (in the interpretative sense), since this frame has salience with earlier literatures that suggest that in religion, philosophy and popular culture, weather and climate has traditionally been held outside of the realms of human influence (e.g. Donner, 2011, 2007; Mortreux & Barnett, 2009; Gifford, 2011).

Through this frame the geoengineering ambitions of the HSRC's ocean fertilization experiment, and indeed most climate action, is deemed nonsensical, even futile. This frame does not however devoid humans of responsibility for their future. Instead the frame conveys a need for humanity to learn to live within the Earth's fixed limits and to do so with modesty and humility. Adapting to changing climatic conditions is at the heart of the 'Living with Nature' strategy, although like the 'Preserving Nature and the HSRC frame' this may also involve austerity; conserving resources impacted by changing conditions and reducing demands on these resources (Box 6.48).

"*I think all we can kind of do is adapt… and hope that the natural system works in our favour*"
- Participant Ricky White

"*There is a lot of oral history in terms of climate… as the glaciers were receding, villages really had to move to higher ground once a generation... We've chosen to put all our infrastructure in vulnerable areas… [which is] very short sighted… Wanting to keep our infrastructure together and to continue the way we are is… just for our own selfishness… [The solution] is more about living with the earth, not trying to conquer her on all levels*"
- Participant Jane Clarke

Box 6.48

6.4 Frame Themes

Through the frames described above we have gained a sense of some of the different priorities, beliefs and values that have been constructed and mobilised through debate about the desirability and feasibility of the geoengineering ambitions of the HSRC. Discourse on the HSRC's ocean fertilization project has been shown to facilitate an interpretation of how participants within the study constructed a varied sense of "our humanness" (Clingerman, 2014: 7), as participants appeared to conceptualise diverse desirable and feasible boundaries between the human and non-human worlds and afford humans different roles and positions in the world around them. Whether framed as 'Mastering', 'Developing', 'Conserving', 'Restoring', 'Preserving', 'Working with' or 'Living with' nature, these roles and responsibilities mingle easily with different ways of conceptualising nature and the human being, including with different ways of conceptualising different forms of divine and natural agency.

These frames can similarly be seen engaging and invoking different values to nature, different notions of 'the good life' and different spiritual, instrumental and emotional relationships to the natural world that are translated into diverse positions about what stands to be lost or gained from attempting to sequester carbon dioxide from the atmosphere through ocean fertilization. Different forms of knowledge are also afforded legitimacy through the frames. Cosmological beliefs, the role of science and instrumental reason and notions of how knowledge can be obtained are contested through the frames. Humans are afforded different intellectual capacities and the potential of science and technology is also debated. The finitude of resources and environmental limits emerge from these debates and different constructions of risk, and the permissibility of that risk, arise from different ideas about the stability of the earth or the fragility of natural systems and the extent to which human management can limit disorder. These frames similarly reveal how such contestation may invoke diverse perspectives about how society should be organised, about the role of governments, regulation and industry and about the role of the economy.

6.5 Moving Forwards Through Q-Methodology

As was discussed in chapter 3, there have been many previous attempts to facilitate the empirical investigation and measurement of many of these 'intangible' constructions of beliefs, meaning, attitudes and values. And while there may appear to be a number of implicit thematic scales within the frames (e.g. intrinsic and instrumental values of nature, techno-optimism and techno-pessimism, preservation and utilization), from this analysis these frames do not appear to neatly or uncomplicatedly map on to any such binary distinctions.

Chapter 3 however made the case for the usefulness of the 'ecological worldview' concept as a conceptual lens through which to go about structuring an analysis of the diverse beliefs, values and assumptions about the role and nature of 'Nature' and human agency in geoengineering debates. 'Worldviews', the reviewed literature told us, are the ultimate justifying ideas through which people interpret, create and make sense of the world around them. "The parts cannot be understood without recognizing how they fit into the whole, and the whole cannot be understood without understanding how the parts interact", Nilsson (2007: 107) writes. Whilst they are rarely without paradox, conceptually 'worldviews' are described as having a certain internal coherency. Hedlund-de Witt (2012: 75) tells us that 'worldviews' are "not a patchwork of loosely related phenomena, but… a coherent pattern or *system* that integrates seemingly isolated ideas into a common holistic structure". Furthermore, while the individual expression of worldviews will remain idiosyncratic, the 'worldview' concept as constructed through the literature reviewed in Chapter 3 also espouses the constructionist notion that through socialisation, discourse and symbol, there will likely be a shared element to 'worldviews' that may make it possible to identify common patterns in individuals' meaning-making.

Inspired by the theoretical basis of the 'worldview' concept, this thesis now turns to Q-Methodology to explore the ways in which different ontological, epistemological and axiological assumptions that shape discussions about the desirability and feasibility of the geoengineering ambitions of the HSRC, (as discussed and debated in the above frame analysis), may interact in social meaning-making. Q-Methodology offers the opportunity to explore how seemingly isolated ideas may be integrated into a common whole, as conceptually the Q-sort process asks participants to consider different ontological, epistemological and axiological assumptions in relation to one another and thus to construct a representation of their 'whole viewpoint' about an issue.

Inverted factor analysis is then used to look for correlations between the ways in which participants model their viewpoint in Q-sorts, to seek out common patterns in participants' meaning making. The viewpoints constructed in participants' individual Q-sorts are then reduced to factors, which are used to represent and interpret shared ways of thinking. As Stephenson (1965: 281) explains,

where a "Q-sort models a person's attitude of mind about a situation", the factors capture "attitudes of mind held in common by many people". Q-Methodology therefore offers the opportunity to explore and infer constellations of underlying collective meaning from the existing analysis, and opens the door to developing an interpretation of the way in which more foundational beliefs may shape the way in which participants within the case study constructed accounts of the desirability and feasibility of the HSRC's geoengineering ambitions.

By providing another methodological window through which to look at the data, this second stage of the research additionally offers the opportunity for a form of triangulation. The frames developed in phase one of the research may not necessarily reflect the participants' intended meanings. Yet during the sorting process participants have the opportunity to (re)impress their own meanings upon the discourse in the Q-set. Factors constructed in the research may contradict, reinforce, supplement or illustrate the findings of this frame analysis, which may allow me to draw conclusions from the data with more confidence than if only one method had been used. A number of scholars have additionally made the argument that Q-Methodology is a more egalitarian form of knowledge production, since the factors themselves are a product of the sorting activity of the participants themselves. This should not be overstated since the factors are still interpreted by researchers, however it is the case that researchers must do their best to respect the contours of this data in the interpretations they offer.

6.5.1 The Q-Set

The first analytical phase of Q-Methodology is the development of the concourse and Q-set (see section 4.3.2.2). This first phase of the research had facilitated a thorough sketching out of relevant aspects of discourse on the desirability and feasibility of the geoengineering ambitions of ocean fertilization in the HSRC case study context. The Q-set was therefore constructed from this concourse with the intention that it engage with and be open to as many aspects of this concourse as possible and that the Q-set be sampled from an understanding of the overall character of the discourse explored in phase one of the research. Bearing in mind the other relevant theoretical conditions for Q-set development, namely that the statements be drawn from as many perspectives as possible and that the statements maintain sufficient ambiguity to leave the statements open to being defined in different ways by different people (discussed in section 4.3.2.2), the statements that made up the final Q-set in this study are listed in Figure 6.1 below.

Figure 6.1: The Q-Set

No.	Statement
1	People who support ocean fertilization haven't taken time to listen to the earth and to feel its power.
2	Using ocean fertilization to force change in our oceans will change us and we will lose our connection to the earth.
3	Natural systems are so interconnected and complex that every time humans try to affect them in one way, something else is affected too.
4	Only science can tell us whether ocean fertilization is a good idea or not.
5	Fiddling around with our environment through ocean fertilization goes against everything that I hold as true and dear.
6	Iron in the ocean is a natural thing and ocean fertilization mimics the natural rhythms of nature.
7	Carbon credits from ocean fertilization could bring much needed income into communities that invest a lot of time and energy into caring for the environment.
8	My feelings on ocean fertilization are informed by an understanding that the natural world needs us to step back and leave it alone.
9	Ocean fertilization should not be done by private companies.
10	We have no way of really knowing what the impact of ocean fertilization will be.
11	Ocean fertilization will be an excuse for greater global governance.
12	Ocean fertilization could easily become an instrument conducive with efforts to oppress less powerful groups in society.
13	If we try to manipulate nature in this arrogant way, the universe will fight back and humans will eventually pay the price.
14	We have already changed the climate system by emitting greenhouse gases. Trying to change it again with ocean fertilization is no different. At least this time we are doing it with our eyes open.
15	My feelings on ocean fertilization are born from a feeling of connection to the earth and to other forms of life.
16	I have huge faith in human ingenuity, but the scale that ocean fertilization would operate at is just too big.
17	My feelings on ocean fertilization are shaped by an understanding that if we are to save the world from dangerous climate change, we need to think big and do so quickly.
18	Ocean fertilization is humans trying to play God.

19	If you think you may have a solution to climate change, then you are morally obligated to pursue it. Ocean fertilization is a good example of this.
20	We need to look for more civilized and precise solutions to climate change than ocean fertilization.
21	Ocean fertilization is unlikely to be used for the betterment of all.
22	Ocean fertilization is a practical response that may help us protect what we have left.
23	Ocean fertilization is morally wrong.
24	The earth cannot cope with the burden of demands currently placed on it. No technological fix, ocean fertilization included, will get us around that fact.
25	If ocean fertilization appears to be having any negative impacts on the environment we can just stop doing it.
26	Ocean fertilization is not dissimilar from the principle of fertilizing our crops, to meet the demands of a rapidly growing global population.
27	I hope that everyone is given the opportunity to understand the science behind ocean fertilization, rather than it being in a small number of hands.
28	Rather than fertilizing the oceans, humans need to learn to live within the Earth's limits.
29	The need for ocean fertilization has been over exaggerated.
30	Ocean fertilization could have disastrous consequences for humanity.
31	Ocean fertilization offers humans the opportunity to grow up and take responsibility for the harm they have caused the environment.
32	I am suspicious of the idea of a 'quick-fix' to climate change.
33	Ocean fertilization is just continuing humanity's attempts to dominate and exploit nature.
34	Ocean fertilization could give humanity an excuse to carry on emitting greenhouse gases, meaning we miss the opportunity to transform our energy and economic systems.
35	I'm worried that people will get greedy, and rush ahead with ocean fertilization.
36	Decision-making on ocean fertilization needs to come from a societal conversation about morality and human values.
37	My feelings on ocean fertilization are shaped by an understanding that human and non-human worlds are entangled. Trying to separate them is meaningless.
38	I find beauty in the idea that through ocean fertilization, humans may be able to acquire the means of stewarding the planet through the challenge of climate change.

39	Ocean fertilization might help us clear up some of the mess we've made, to help bring the Earth back to health.
40	Ocean fertilization takes humanity too far into an artificial world and away from the natural order of things.
41	My feelings on ocean fertilization are shaped by the understanding that if you take care of the Earth, it is going to take care of you.
42	We won't know if ocean fertilization will work until we try.
43	I think humans are perfectly smart enough to embark on ocean fertilization.
44	Governments are failing to take climate change seriously, so citizens need to develop their own solutions, such as ocean fertilization.
45	Debate about ocean fertilization is, in large part, driven by a lack of public education.
46	My views on ocean fertilization are informed by my discomfort with the idea of 'managing' natural systems.
47	It's too late to just start treading more lightly and polluting less. We need ideas like ocean fertilization to undo some of the harm we've already caused.

Chapter 7: The Q-Methodology Study

This chapter makes the final empirical contribution to this thesis by reporting on the results of the Q-Methodology study and offering an interpretation of the desirability and feasibility of ocean fertilization from each of the factors generated from the analysis. As outlined in section 4.3.2, 26 purposively sampled participants completed the Q-sort exercise, sorting the 47 Q-statements presented in Figure 6.1 onto an 11-point approximately normally distributed Q-sort matrix (see Figure 4.3). The participants used these statements and the matrix to respond to the sorting instruction in Box 7.1.

> **"Alongside the goal of salmon restoration, the Haida Salmon Restoration Corporation hopes to sequester carbon dioxide, through ocean fertilization, in order to reduce the scale of human-induced climate change. How do you feel about exploring ocean fertilization to sequester carbon dioxide in the ocean?** Please sort the provided statements in the order that best describes your point of view".
>
> *Box 7.1*

This chapter now reports the findings of this analysis and offers an interpretation of ocean fertilization as it is constructed through each of the factors generated from this analysis.

7.1 Statistical overview

The data from the 26 participants' completed Q-sorts was analyzed using the statistical software PQMethod, a free, dedicated DOS-based Q-package developed by Peter Schmolck (Schmolck, 2014). Varimax rotation, a facility available within PQMethod, was used to produce the most orthogonal (uncorrelated) factors possible[134]. The merits of hand-rotation in Q-methodology, a process that relies more on 'the feel' (Watts & Stenner, 2012) of the data, have been argued to be more appropriate than varimax for some studies (Brown, 1980; Brown & Robyn, 2004, 2003; Stephenson, 1953). However after careful consideration of the data from various 'vantage points', the statistical operation of varimax was chosen to maximise the overall study variance explained by the factors.

As discussed in section 4.3.4.1, and as argued by Watts & Stenner (2012: 125, original emphasis), a varimax rotation may be preferable in research using an inductive analytic strategy, which seeks to 'let the data guide the analysis' (as far as is possible!). It is also used where a researcher wishes to

[134] It is important to appreciate that while factor rotation alters the position of the factors within the conceptual space relative to the Q-sorts, the positions of the Q-sorts themselves are fixed by their unrotated factor loadings. No rotation can force a Q-sort to share more in common with the group, thus the Q-sorts' *communality* – which measures how much a Q-sort holds in common with the other sorts – does not change (Watts & Stenner, 2012: 104).

capture the viewpoints of the majority of the corpus of participants, since "the method's desire to maximise the variance explained… means it is always *drawn towards the crowds*". Notably by-hand rotations, dependent on researcher fiat, have the inverse strengths and can be used to reveal more marginal perspectives that could be more easily lost through varimax rotation. This Q-sort may accordingly suffer from this limitation, failing to adequately reflect minority perspectives. However the frame analysis in phase one of the research drew out some of these complexities and given the research aim to reveal shared perspectives within the study sample, and thus to pursue "constructions and representations of a *social* kind" (Watts & Stenner, 2005a: 71), it was felt to make theoretical sense to pursue a solution that maximised the amount of the total study variance explained (Watts & Stenner, 2005a).

7.1.1. A Two Factor Solution

Analysis resulted in the identification of two factors, explaining 50% of the study variance; a result that compares well with the variance explained by other Q-studies and with the general rule that solutions explaining 35-40% or more of the study variance can be considered sound (Kline, 1994). This solution accounts for the Q-sorts of 19 out of the 26 participants at the 99% confidence level, and 21 out of 26 participants at the 98% confidence level; meaning that at the 99% confidence level 19 out of the 26 participants load significantly onto only one factor.

Three of the sorts were 'confounded', meaning that they load significantly onto both factors: Two of these sorts loaded onto both factors at the 99% confidence level and the other one loaded onto both factors at the 98% confidence level. Two participants did not load significantly onto either factor at the 98% or 99% significance levels. In this solution the Q-methodology convention for each factor to have at least two 'factor exemplars' (sorts that load significantly onto that factor alone) is met. Further the two factors rendered in this solution satisfy the Kaiser-Guttman criterion (Guttman, 1954; Kaiser, 1960), which demands that extracted factors have an eigenvalue in excess of 1.00. The eigenvalue is a measure of the explanatory power of an extracted factor and this rule helps ensure an efficient reduction of the correlation matrix, since a factor with an eigenvalue of less than 1.00 accounts for less of the study variance than would an individual Q-sort (Watts & Stenner, 2005a).

In this study a three-factor solution would have also satisfied the Kaiser-Guttman criterion, wherein a third factor with an eigenvalue of 1.07 could have been retained, to explain a further 4% of the study variance. However the Kaiser-Guttman rule has been criticised for effectively being too arbitrary (Brown, 1980) and most particularly for encouraging solutions with too many meaningless or 'spurious' factors (e.g. Cattell, 1978; Wilson & Cooper, 2008). As Watts & Stenner (2012: 95) write, "factor analysis does not automatically resolve itself into a single, universally

acceptable solution". Deciding into how many pieces to "slice the cake" (*i.bid*) depends on an analytic strategy that follows statistical signals within the data, but that also makes space for researchers to be guided by the more subjective 'feel' and coherence of that data (Coogan & Herrington, 2011).

While the analytical strategy of this research was to listen to the data as far as possible, the notion of unadulterated induction is a theoretical fallacy and this thesis pursued a more 'informed' approach to grounded theory (see section 4.2.4.1): A scenario Watts & Stenner (2012: 96) summarize powerfully by arguing "we'd hardly be human, let alone good academics, if we didn't harbour some expectations about our subject matter". Given these considerations, while a three factor solution and its explanatory power was thoroughly investigated in relation to the study aims and purposes, in the end a two factor solution was felt to produce a statistically acceptable solution that also made better sense of the data.

The rationale behind a two-factor solution providing a more powerful and meaningful explanation of the data pertained in part to the fact that under a varimax-rotated 2-factor solution Factor 1 is bipolar, defined by 12 sorts loading significantly, both positively and negatively, onto this factor. This represents two opposed viewpoints captured within the sample being expressed in this one factor. In Q-Methodology it is possible to interpret each viewpoint within this factor as a mirror image of the other (Watts & Stenner, 2005b). The ideas (represented through Q-statements) that are of vital importance to those sorts positioned at one pole of the factor, sorts positioned at the other end of the pole may reject outright.

Factor 1 was still bipolar under a three factor solution, however only confounded sorts loaded significantly onto the negative pole of Factor 1, and all of these also loaded significantly onto Factor 3. This distribution suggested that this solution could be forcing the split of one unifying factor. Researchers must present a second interpretation of bipolar factors, in order to capture the viewpoint expressed by the sorts that load on the negative pole. However under these circumstances, offering a second interpretation of Factor 1 from the viewpoint of the negative pole would have been difficult to interpret, as well as to justify, since this would have demanded the interpretation of two different points of view (Factor 3 and the negative pole of Factor 1) based on the same sorts.

7.1.2. When Two Factors Become Three

Commonly the second interpretation of a bipolar factor – to account for the sorts that load significantly negatively onto the factor as well as those that load significantly positively onto the factor – is achieved by interpreting the factor array twice: The latter time using an array that is the

mirror image of that used to interpret the viewpoint of the positive pole and which is generated by manually turning the whole array back to front (Watts & Stenner, 2012).

In this study however Factor 1 is defined by several sorts at each of its poles and in such instances Brown (1980: 253) recommends rather than reporting only one factor - the negative end merely a reflection of the positive end – creating instead separate factors to represent the two poles. This strategy he argues "permits whatever specificity that might exist at either pole to assert itself in the factor scores"[135]. Using the QROT function in PQMethod, Factor 1 was therefore retained twice to create three factors within the project. The factor reflection option in PQMethod allowed the factor loadings to be reversed to form Factor 1b, and then only the sorts positively correlated with each factor were used in the construction of factor estimates. This process resulted in the original two-factor solution, becoming effectively a three-factor solution, where Factor 1a and Factor 1b are highly negatively correlated (-0.72).

7.1.2.1 Factor Estimates and Factor Arrays

To facilitate interpretation of the factors, an estimate of each factors' viewpoint is needed in the form of an interpretable item configuration characterizing that factor (Watts & Stenner, 2005a). These are typically obtained through the preparation of 'exemplary Q-sort' factor estimates, based on a weighted average of all the individual Q-sorts which load significantly onto a given factor. Factor loadings reveal how close a given Q-sort is to the pole of a given factor or, in the words of Watts & Stenner (2012: 128) these numbers tell us "*how closely it approximates a factor's viewpoint"*. In this research sorts with a single rotated factor loading in excess of 0.51 (significant at the $p < 0.01$ level[136]) were considered to closely approximate the viewpoint of a factor and were used in constructing factor estimates.

There could be debate about whether a factor loading of 0.51 approximates this viewpoint 'closely enough', since 0.51 is clearly still a long way from the factor pole. However factor estimates are generated through averages, which become more stable when defined by more scores. Coupled with the understanding that factor estimates are derived from weighted averages which provide proportional contributions to the factor estimates, using all statistically significant sorts was felt to be the best way of increasing the reliability of the estimates. Figure 7.1 below identifies the sorts that define each factor under these conditions, and which were 'flagged' in PQMethod to generate the factor estimates[137]. Confounded sorts were not used in the construction of the factor estimates (c.f. Watts & Stenner, 2012).

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[135] For an example, see Brown and Ungs (1970)

[136] Calculated through the equation: 2.58 x (1/√No. of items in Q-set).

[137] The factor estimates are generated automatically in PQMethod, but for an overview of how these factor weights and estimates are calculated see Brown (1980: 241-242).

Figure 7.1 Factor Matrix Indicating Defining Sorts

Pseudonym	1a	1b	2
1. Russell Anderson	-0.5796	**0.5796****	0.1723
2. Katherine Young	**0.6476****	-0.6476	0.4457
3. Theresa Page	0.432	-0.432	**0.5174****
4. Marlene Hawkins	**0.573****	-0.573	0.379
5. Brent Morton	-0.5068	**0.5068****	0.3972
6. Ronnie Stevenson	0.3015	-0.3015	0.2374
7. Chris Shaw	0.4611	-0.4611	0.3017
8. Noel Townsend	**0.5656****	-0.5656	0.3311
9. Ben Watson	0.0273	-0.0273	0.4674
10.Raymond Wallace	-0.735	**0.735****	-0.1126
11. Harry Doyle	**0.7617****	-0.7617	0.2992
12. Kelly Baker	0.4751	-0.4751	0.4895
13. Gary Bennett	0.5036	-0.5036	**0.6683****
14. Joe Newman	-0.7543	**0.7543****	-0.2029
15. Jan Fields	0.3881	-0.3881	0.4187
16. Lewis Fletcher	0.4159	-0.4159	**0.6401****
17. Olivia James	0.5888	-0.5888	0.5725
18. Max Cannon	0.1165	-0.1165	**0.7256****
19. Charlotte Elliott	**0.7355****	-0.7355	0.3311
20. Ross Poole	-0.0992	0.0992	**0.5698****
21. Susan Hughes	-0.7434	**0.7434****	0.0485
22. Lloyd Jones	-0.3136	0.3136	**0.5494****
23. Ruth Carter	0.0819	-0.0819	**0.6486****
24. Rob Peters	-0.7691	**0.7691****	0.037
25. Marianne Dunn	0.5438	-0.5438	0.6858
26. Ryan Carr	-0.8656	**0.8656****	-0.0412
% expl.var.	**30**		**20**

Defining sorts are those indicated with a double asterisk which load positively on only one factor at $p < .01$. (0.51 = 99% significance level; 0.46 = 98% significance level; 0.38 = 95% significance level).

As shown in Figure 7.2 below, z-scores (normalised item scores which facilitate cross-factor comparison) for each of the items in the Q study were then rank ordered to convert these scores into a single factor array. This array converts the data held in z-scores into the same form as that in which the data was originally collected; in terms of a complete pattern of responses to the sorting instruction. The items with the two highest ranking z-scores are awarded a factor array ranking of +5 (e.g. statements 13 and 18 for factor 1a), the items with the next three highest ranking z-scores are awarded a ranking of +4 and so on, to fill the 47 square, normally distributed grid.

Transposing z-scores into factor arrays is not necessary for factor interpretation (Zambelli & Bonni, 2004). In fact this process actually entails a loss of information as scale data is converted into ordinal data. Yet this step remains standard practice in Q-methodology. As Brown (1980: 243) argues, these arrays "conform to the format in which the data were originally collected", and thus these arrays are more understandable to a papers' readership than their z-score counterparts. More than this, Watts & Stenner (2012: 141) argue that these arrays better acknowledge the holism inherent to Q-methodology where items are considered relative to one another; a sort is used to represent a viewpoint as a whole and analysis depends on the intercorrelation of whole sorts. Afterall, as summarized by Watts & Stenner (2012: 143), "the factors are [treated as] viewpoints in their own right, so representing them in the form of a single Q-sort provides a pleasing methodological symmetry".

Significantly this array will only ever be an estimate from which to construct interpretations of shared meaning from the discourse, and the arrays themselves will inevitably contain error, since no participant loads 100% on any factor. Nevertheless, along with the qualitative data collected alongside the sorts, these arrays can be used as a powerful tool in the interpretation of the study factors and thus of interpretation of the ways in which different ontological, epistemological and axiological assumptions about the role and nature of 'nature' and human agency may interact in participants meaning-making on ocean fertilization. The factor arrays for this research are displayed in Figure 7.2 below. By column, the table reveals the comparative ranking of statements which exemplify a given factor. These have been transposed into matrix format in appendix 7.1.

Figure 7.2: The Factor Arrays: Factor Q-Sort Values for Each Statement			
Statement	**Factor**		
	1a	**1b**	**2**
1. People who support ocean fertilization haven't taken time to listen to the earth and to feel its power.	1**	-4	-2
2. Using ocean fertilization to force change in our oceans will change us and we will lose our connection to the earth.	1*	-1	-1
3. Natural systems are so interconnected and complex that every time humans try to affect them in one way, something else is affected too.	3	2	5**
4. Only science can tell us whether ocean fertilization is a good idea or not.	-2**	4**	1**
5. Fiddling around with our environment through ocean fertilization goes against everything that I hold as true and dear.	4**	-5**	0**
6. Iron in the ocean is a natural thing and ocean fertilization mimics the natural rhythms of nature.	-4	2**	-3
7. Carbon credits from ocean fertilization could bring much needed income into communities that invest a lot of time and energy into caring for the environment.	-4**	1**	0**
8. My feelings on ocean fertilization are informed by an understanding that the natural world needs us to step back and leave it alone.	1	-2**	1
9. Ocean fertilization should not be done by private companies.	0**	-3**	3**
10. We have no way of really knowing what the impact of ocean fertilization will be.	2**	-1	0
11. Ocean fertilization will be an excuse for greater global governance.	0	0	-3**
12. Ocean fertilization could easily become an instrument conducive with efforts to oppress less powerful groups in society.	-1	-1	-4
13. If we try to manipulate nature in this arrogant way, the universe will fight back and humans will eventually pay the price.	5**	-4**	1**
14. We have already changed the climate system by emitting greenhouse gases. Trying to change it again with ocean fertilization is no different. At least this time we are doing it with our eyes open.	-2	3**	-2

15. My feelings on ocean fertilization are born from a feeling of connection to the earth and to other forms of life.	1	0	2
16. I have huge faith in human ingenuity, but the scale that ocean fertilization would operate at is just too big.	-1	-2**	0
17. My feelings on ocean fertilization are shaped by an understanding that if we are to save the world from dangerous climate change, we need to think big and do so quickly.	-2	2**	-1
18. Ocean fertilization is humans trying to play God.	5**	-4**	-1**
19. If you think you may have a solution to climate change, then you are morally obligated to pursue it. Ocean fertilization is a good example of this.	-2	3**	-5
20. We need to look for more civilized and precise solutions to climate change than ocean fertilization.	3	-1**	4
21. Ocean fertilization is unlikely to be used for the betterment of all.	0*	-3**	2*
22. Ocean fertilization is a practical response that may help us protect what we have left.	-3**	3**	-1**
23. Ocean fertilization is morally wrong.	4**	-5**	-2**
24. The earth cannot cope with the burden of demands currently placed on it. No technological fix, ocean fertilization included, will get us around that fact.	-1	-2	3**
25. If ocean fertilization appears to be having any negative impacts on the environment we can just stop doing it.	-1**	5**	-4**
26. Ocean fertilization is not dissimilar from the principle of fertilizing our crops, to meet the demands of a rapidly growing global population.	-1	2**	-3
27. I hope that everyone is given the opportunity to understand the science behind ocean fertilization, rather than it being in a small number of hands.	0*	2	3
28. Rather than fertilizing the oceans, humans need to learn to live within the Earth's limits.	2**	0**	5**
29. The need for ocean fertilization has been over exaggerated.	-1	-3**	-1
30. Ocean fertilization could have disastrous consequences for humanity.	4*	-3**	2*

31. Ocean fertilization offers humans the opportunity to grow up and take responsibility for the harm they have caused the environment.	-3	0**	-5
32. I am suspicious of the idea of a 'quick-fix' to climate change.	3	-1**	4
33. Ocean fertilization is just continuing humanity's attempts to dominate and exploit nature.	1	-2**	0
34. Ocean fertilization could give humanity an excuse to carry on emitting greenhouse gases, meaning we miss the opportunity to transform our energy and economic systems.	0	-1**	2
35. I'm worried that people will get greedy, and rush ahead with ocean fertilization.	2	0	1
36. Decision-making on ocean fertilization needs to come from a societal conversation about morality and human values.	3	0	1
37. My feelings on ocean fertilization are shaped by an understanding that human and non-human worlds are entangled. Trying to separate them is meaningless.	1	1	2
38. I find beauty in the idea that through ocean fertilization, humans may be able to acquire the means of stewarding the planet through the challenge of climate change.	-3	4**	-3
39. Ocean fertilization might help us clear up some of the mess we've made, to help bring the Earth back to health.	-4*	3**	-2*
40. Ocean fertilization takes humanity too far into an artificial world and away from the natural order of things.	2	-2**	1
41. My feelings on ocean fertilization are shaped by the understanding that if you take care of the Earth, it is going to take care of you.	2	1	4*
42. We won't know if ocean fertilization will work until we try.	-5**	5**	-1**
43. I think humans are perfectly smart enough to embark on ocean fertilization.	-5	1**	-4
44. Governments are failing to take climate change seriously, so citizens need to develop their own solutions, such as ocean fertilization.	-2**	1*	0*
45. Debate about ocean fertilization is, in large part, driven by a lack of public education.	0	1*	0

46. My views on ocean fertilization are informed by my discomfort with the idea of 'managing' natural systems.	0	0	3**
47. It's too late to just start treading more lightly and polluting less. We need ideas like ocean fertilization to undo some of the harm we've already caused.	-3	4**	-2

Distinguishing statements – a statement that is placed in a statistically different position ($p < .05$) on the Q-sort grid by participants that load on a given factor, to where participants that load on other factors have placed the same statement - for each factor are indicated with an asterisk. A double asterisk indicates significance at $p < .01$.

7.2 Factor Interpretation

While Figure 7.2 quantitatively presents the configurations of statements which characterize different factors, Q-methodologists method of choice for presenting factors is in narrative (Watts & Stenner, 2012) or commentary form (e.g. Capdevila & Stainton Rogers, 2000; Jordan et al., 2005; Stenner et al., 2008). Stephenson (1936a) emphasizes the key difference between Q-methodology and by variable, or by item, methods of data collection lies in the holistic nature of the Q-methodological process. The factors constructed in Q-methodology cannot be reduced to their component parts but rather are interpreted on the basis of the ways in which different themes and ideas are configured and connected by participants. This holistic approach to interpretation echoes Hedlund-de Witt's (e.g. 2012) characterization of 'worldviews' as all encompassing common holistic structures, and thus formed part of the rationale for method selection. This holism accordingly needs to remain at the heart of factor interpretation in order to maximise the method's potential and stay true to its design.

Watts & Stenner, (2012: 149, original emphasis) argue that this requires factor interpretations take into account of "the *entire item configuration*" in a factor array. Such an approach requires exploration of the factors beyond just the limited number of items situated within the highest and lowest rankings of a factor array, or just those that cross-factor item comparisons reveal to be ranked in a statistically different way to the other factors (see the distinguishing statements highlighted in Figure 7.2 above). Although both of these are undoubtedly important dimensions to the analysis, if these configurations are to be treated as gestalt entities the interrelationships between items within factors must also be attended to.

To aid this interpretative process, which is often 'black-boxed' in the literature, crib sheets, based on a system developed by Simon Watts (see Watts & Stenner, 2012: 150-155), were constructed to help ensure a systematic and encompassing analytical approach, wherein every item within the array was engaged with. These can be found in appendices 7.2, 7.3 and 7.4. Notably not all items that appear on these crib sheets are necessarily ranked differently to their ranking in the other factors in a statistical sense. Rather these sheets provide a more holistic and inclusive means of considering

the meaning and significance of items positioned across the array, whilst making space for items within the middle of the distribution to assert their importance on the occasions where they may be salient.

What follows is the narrative account of each factor. These narrative accounts were developed through abductive reasoning (Haig, 2008, 2005; Shank, 1998), wherein I have tried to offer an interpretation of why the individual items and their interrelationships may be manifesting in these particular ways within the factor arrays. Observations are treated as 'clues' to the reasons why certain patterns of correlation have emerged. The analysis depends upon these 'clues' being traced back to develop a clear understanding of the factor, or the "overall viewpoint that explains or makes sense of the configuration", with the aim of providing "a plausible theoretical explanation of their appearance" (Watts & Stenner, 2012: 40).

These accounts directly cite relevant Q-statements within the text, in order that readers may more easily trace my logic to the quantitative accounts of the factors. The statements' factor array rankings are also highlighted in the text and if a statement is a distinguishing statement for that factor – occupying a statistically significant position on the Q-sort grid to those occupied by the other factors – this too is highlighted using the asterisk system developed in Figure 7.2: A single asterisk indicates a statistically different position at $p < .05$ and a double asterisk indicates a statistically different position at $p < .01$. In brackets, the relevant statement is identified, and is preceded by a colon and its accompanying factor array score[138].

Qualitative comments gathered from participants during the Q-sort process then helped develop and elabroate these interpretations. The resulting interpretations aim for a narrative account of "how things must *feel* for anybody who shares this viewpoint" (Watts & Stenner, 2012: 158, original emphasis), which Watts & Stenner (*i.bid*) emphasize means interpretations should not be too dry or clinical. Rather the interpretations aim to engage with the sentiment behind the factors. The readership should be able to experience how the issue looks and feels from the viewpoint being expressed in the interpretation (*i.bid*).

To further embrace this commitment to engaging with the *feeling* of a factor, interpretations in this study are also named and are embellished by the comments of significantly loading participants, collected alongside the sort itself as supporting qualitative data (c.f. Baker, 2006). "Including the participant's own words is a simple and effective means of bolstering the first-person nature, as well as the passion, of the final account", Watts & Stenner (2012: 162-163) explain. "It can also be a useful way of reinforcing the accuracy and efficacy of… interpretation of specific item rankings".

[138] For example statement 13, which has a factor array ranking of +5 and occupies a statistically unique ranking at the $p < .01$ level would be referenced within the text using the following designation: (13: +5**).

In keeping with constructivist traditions, there is no escaping the fact that factor interpretation is a creative process (section 4.3.1). Subtly different emphases within interpretations will always be feasible and thus, as with all interpretative research, the final output will unavoidably be an expression of researcher meaning-making. The paradigmatic foundations of such an approach have been actively embraced throughout this thesis (see section 3.6). However unlike with less structured interpretative methods, the parameters of factor interpretation in Q-methodology – "*what you can get away with saying*" (Watts & Stenner, 2012: 163, original emphasis) - are more restrained through the structure of the factor array. Any failure to respond meaningfully to the factor exemplifying item configurations can be easily detected.

Watts & Stenner (2005a: 85) capture this dynamic well when they write that "in common with most hermeneutic endeavours, Q data makes it relatively simple to reject incompetent readings, whilst allowing scope for numerous subtly different competent readings to co-exist". Acknowledging that the notion of a 'perfect' end product is untenable theoretically, in the following factor interpretations every effort has been made to represent each factors' account of ocean fertilization in a way that would be meaningful to participants with significantly loading sorts.

Interpretations of each factor will now be offered and each factor will be named, to provide an "identity for a factor" (Watts & Stenner, 2012: 160). A demographic summary of the participants whose sorts defined each factor is offered in Figure 7.3 below.

Figure 7.3 A demographic summary of the participants whose sorts defined each factor

Factor	Title	Significantly loading participants	HSRC Affiliates: Non-Affiliates	**Ethnicity** Haida: Non-Haida	**Gender** Male: Female
1a	Ocean fertilization is morally wrong. We need to preserve the natural order.	n=5	0:5	4:1	2:3
1b	Ocean fertilization should be urgently explored. Through science we can respond to the challenges of climate change.	n=7	5:2	2:5	6:1
2	Climate and ocean systems are dynamic and interconnected. Ocean fertilization is very risky	n=7	0:7	0:7	5:2

7.3 Interpretation of Factor 1

Factor 1 has an eigenvalue of 7.8[139] and explains 30% of the total study variance: i.e. 30% of the "full range of meaning and variability" captured by the study (Watts & Stenner, 2012: 98). Factor 1a

[139] Eigenvalues are calculated by multiplying the number of participants by the variance and dividing this result by 100.

and Factor 1b are significantly negatively correlated ($p < .01$), as both are products of a bipolar Factor 1, split to create separate factors (see appendix 7.5).

7.3.1 Factor 1a: Ocean fertilization is morally wrong. We need to preserve the natural order.

Demographic and Statistical Profile – Five participants (Katherine Young, Marlene Hawkins, Noel Townsend, Harry Doyle and Charlotte Elliott) are significantly associated with this factor at the 99% significance level ; three female and two male. Four out of these five participants identify as ethnic Haida (Katherine Young, Marlene Hawkins, Noel Townsend and Charlotte Elliott). However results do not suggest this perspective is uniquely Haida: Including Harry Doyle, three non-Haida participants load significantly onto this factor (at the 99% significance level), although two of these participants (Olivia James and Marianne Dunn) sorts are confounded, also loading significantly onto Factor 2.

Interpretation – Echoing the 'Mastering Nature and the HSRC' frame in chapter 6, Participants that load onto Factor 1a typically express a commitment to the idea that the world has an inherent 'natural order' and that through ocean fertilization humans risk overstepping their place in this order and intruding into realms in which they don't belong. Whilst Nature may be revered simply for Nature's sake, rather than necessarily being understood as a divine creation, these concerns find expression in the nomenclature that through ocean fertilization humans are effectively 'Playing God' (18: +5**).

As seen in the 'Preserving Nature and the HSRC' frame, the act of humans adding iron to the ocean is considered 'unnatural' and any claims that ocean fertilization is mimicking nature or working with natural processes, as were constructed through the 'Working with Nature and the HSRC' frame, are dismissed out of hand. This is expressed, for example, through disagreement with item 6, "Iron in the ocean is a natural thing and ocean fertilization mimics the natural rhythms of nature" (6: -4), where the intentionality of human agency tended to form the basis of these objections. "*I don't agree with this, because it's, we are manipulating it*", responded Noel Townsend. "*It's another step*", Harry Doyle explained (14: -2).

Thus through ocean fertilization humans risk disrupting this natural order and taking humanity too far into an "artificial" world (40: +2). This natural order is itself of inherent value and thus humans "fiddling" around with the environment through ocean fertilization upsetting this order, is seen as offensive and vulgar (5: +4**, 38: -3). This combination of humans overstepping their authority and creating 'unnatural' systems means ocean fertilization is morally wrong (23: +4**) and risks bringing humans into a fundamentally unnatural relationship with nature (2: +1*)

Humans lack the capability to embark on a project on the scale of ocean fertilization (43: -5) or to anticipate the impacts of such an intervention (10: +2**). This makes ocean fertilization impractical (22: -3**). But there are also likely to be severe consequences for attempting to try to manipulate the ocean and climate systems through ocean fertilization (30: +4*).

These consequences may not result just from failing to sufficiently understand the systems involved (c.f. 'Conserving Nature and the HSRC' frame, section 6.3.3). Rather, as constructed in the 'Mastering Nature and the HSRC' frame (section 6.3.1), the earth may have its own untameable power, which ocean fertilization proponents overlook (1: +1**). Ocean fertilization is an act of hubris and human arrogance, which represents humanity attempting to dominate and exploit nature (33: +1). It could therefore result in karmic retribution and punishment as the universe fights back and humans pay the price for their egotism (13: 5**). As Charlotte Elliott responded: "*After the story [of the HSRC project] broke in the news that's when we started [getting] the earthquakes here too… you don't call them acts of God for no reason, you know*". Some of these ideas are also drawn together in the following response from Katherine Young: "*Everything that we learn here in Haida Gwaii from our cultural teachings is that you don't disrespect the environment. You don't play with nature and if you do there's big consequences. So fighting fire with fire isn't going to put out the flames of climate change*".

Accordingly it may not be possible to just reverse the effects of ocean fertilization, once we've embarked upon doing it. Actions have consequences in these interconnected natural systems (3: +3) and starting ocean fertilization in the first place may set in way a chain of negative impacts on the environment for generations to come (25: -1**) (c.f. 'Conserving Nature' frame, section 6.3.3).

On the other hand there is, in the words of Macnaghten & Szerszynski (2013: 465), no need to live the "global social experiment", since we can know that ocean fertilization won't work in advance of deployment (42: -5**). Laboratory studies and smaller-scale field trials may have a role to play, but this viewpoint underscores the importance of other forms of knowledge, including instinct, experiential knowledge and moral reasoning (13: 5**). It's not only science that can tell us whether ocean fertilization is a good idea or not (4: -2**), but rather as Katherine Young describes, "*it's in our instincts and our culture. And reasoning and morality can tell us that as well*" (c.f. 'Mastering Nature' frame, section 6.3.1).

In this viewpoint there is also more resistance to the idea that science could ever come up with definitive answers about the impacts of ocean fertilization as well as to the positivist assumption that science can be policy prescriptive. Harry Doyle captures some of this latter sentiment in his reaction to item 4 (-2**): "*Science isn't the only gauge of whether it's a good idea or not. I mean morality doesn't always coincide with science right… There's a collective consciousness of humanity that has voices through other*

venues… the church as one collective body is you know, another method. Fringe groups that aren't necessarily academic in background have different reasons for opposing anything like this as well". By emphasizing the necessarily normative nature of ocean fertilization, this viewpoint also does not buy into the idea that education alone will resolve contestation about ocean fertilization (45: 0). Instead it emphasizes that decision-making on ocean fertilization needs to be informed by a reflexive societal conversation about morality and human values (36: +3).

Because of commitment to the value of local, experiential knowledge, this viewpoint is more fearful of the potential for ocean fertilization to draw decision making outside of the communities that decisions affect. This is captured to some extent by Harry Doyle who, in reaction to item 11, expressed concern that "*if we go down the path of accepting a process like ocean fertilization, that will to a certain degree put the power of altering global climate conditions into the hands of a few*" (11: 0). Local experiences of subjugation and disempowerment were drawn on by participants loading onto this viewpoint to express the reasons why giving these powers to a small number of people, removed from the communities affected by their decisions, is so concerning. "*Well it means that these global people have no idea how we feel on Haida Gwaii but they go ahead and make decisions for us anyway. Like the decision to take all our children away from us in the late 1800s, you know. Who the fuck thought of that ey? So yeah. It's stupid. We're tired of people way over there doing our, taking away our arts*" (Marlene Hawkins).

Having science on ocean fertilization available to all is therefore important to this viewpoint (27: 0*). However overwhelmingly the value of this transparency is petered by a commitment to the idea that ocean fertilization simply shouldn't be done, since it won't work and may only make things worse (39: -4*, 22: -3**) (c.f 'Preserving Nature and the HSRC' frame).

This viewpoint considers ocean fertilization sceptically in part due to the assumption that controlling natural systems is not possible (46: 0): "*Well we can't manage the natural systems. Whenever we try, it's a hopeless disaster when we try and manage natural systems. It's not up to us. The creator didn't put us here to diddle around with what he'd made perfect in the beginning*" (Marlene Hawkins). But that is not to say that humans are afforded a passive role in this viewpoint (8: +1), since this group are concerned about the human impact on the planet (29: -1) and current inaction to address this impact (44: -2**).

Instead as Harry Doyle summarizes "*mankind is involved in every natural system on the planet now, so we need to have some kind of managerial process in place to maintain or recoup what we've lost*". Resolution is not going to be found through a quick-fix (32: +3) and humans need not to try to "*think big and do so quickly, [since] that's always been one of the problems that's got us in to half the messes we're in*" (Harry Doyle) (17: -2). Rather redress is sought through preservationist commitments to treading more lightly and

polluting less (47: -3), which are seen as more 'civilized' and precise solutions to climate change (20: +3).

Charlotte Elliott summarized this in response to item 8 (+1): "*it's not really true to say to leave it alone because we have to do our part by treating it with more respect you know. Doing more of the things that we can do to help, like we were talking about, you know. Like riding bikes and disposing of our garbage in a better manner and all that kind of stuff*".

Humans need to learn to live within the Earth's limits (28: 2**) and ocean fertilization arises from people failing to recognise this need. Because ocean fertilization would be so ineffective, communities would not have the opportunity to benefit from carbon credits in exchange for taking on these projects this viewpoint attests (7: -4**). And regardless ocean fertilization remains undesirable since this would just facilitate companies exploiting the environment and "*buying the right to pollute*" (Charlotte Elliott) (34: 0). Ocean fertilization "*shouldn't be done by anybody*" (Harry Doyle) this viewpoint denotes. But it especially shouldn't be done by private companies (9: 0**), which are driven by profit (35: +2) rather than in the interests of all (21: 0*) (c.f. 'Preserving Nature and the HSRC' frame).

7.3.2 Factor 1b: Ocean fertilization should be urgently explored. Through science we can respond to the challenges of climate change.

Demographic and Statistical Profile – Seven participants (Russell Anderson, Brent Morton, Raymond Wallace, Joe Newman, Susan Hughes, Rob Peters, Ryan Carr) are significantly associated with this factor at the 99% significance level; six male and one female. Two out of these seven participants identify as ethnic Haida (Brent Morton and Susan Hughes) and five out of the seven participants were, or had been, affiliates of, or employed by, the HSRC (Brent Morton, Raymond Wallace, Joe Newman, Rob Peters and Ryan Carr).

Interpretation – Participants that load onto Factor 1b tend to express frustration with the idea that rather than fertilizing the ocean the human race just needs to learn to live within the Earth's limits, (28: 0**), as they contest the feasibility of this. "*That train has sailed*", Russell Anderson remarked, and all that has been left in its wake is inaction (44: +1*).

Now it's too late to just start treading more lightly and polluting less. We need ideas like ocean fertilization to undo some of the harm we've already caused (47: +4**). "*I have grown up with the message of reducing our environmental impact and 'saving the planet'... to what effect? I think it's naive to believe that we can 'end our dependence on fossil fuels' in time for that effort to have the desired effect. People who still think*

that's a viable solution fail to understand the scale on which our society depends on these fuels", responded Ryan Carr.

Accordingly, reflecting climate emergency rhetoric discussed in the 'Conserving Nature and the HSRC' frame (section 6.3.3), this factor attests that those who continue to perpetuate the 'myth' that the dangers of anthropogenic climate change can be resolved solely through mitigation are naïve and their are attitudes dangerous, since the need for immediate and practical solutions to climate change is very real (29: -3**). Instead, we need to think big and do so quickly (17: +2**, 35: 0).

Echoing 'political realism' framings, in the face of deficient global governance on climate change (11: 0), this factor suggests that the onus to develop solutions like ocean fertilization falls to citizens (44: +1*) and private companies (9: -3**). As seen in the 'Developing Nature and the HSRC frame', private entities are considered to be good candidates for the job given that they are "*usually fairly efficient at what they do*" (Participant Russell Anderson). This onus manifested among some participants as effectively a moral obligation (23: -5**, 19: +3**). As Participant Raymond Wallace reasoned, *"Canada is going in the wrong direction as fast as it can go. Therefore if you're informed and you get the problem and you think you have a solution, you're morally obligated to do something about it… [To not do so] is almost the definition of criminal negligence".*

This viewpoint also attests that carbon credits from ocean fertilization could bring much needed income into communities that invest a lot of time and energy into caring for the environment (7: +1**). This is "*a good thing*" since "*what can you do without money? If we want us to get educated, we need money for that. We have hopes and dreams like anybody else"* Susan Hughes responded, reflecting on the ambitions of the HSRC project. More than this carbon credits "*allow you to create an industry which monetises on reversing pollution… that could be self-funding and allow this [ocean fertilization] to continue in perpetuity"*, Joe Newman explains. Then "*an economy can be created, that has a net positive environmental impact".*

Reflecting again the 'Developing Nature and the HSRC' frame, in many ways this viewpoint offers an account of classic techno-optimism. Humans are an incredible, powerful, creative force and, with the right investment and resourcing, have amazing capacity to innovate and develop the means of overcoming environmental challenges like climate change (32: -1**, 1: -4, 24: -2, 13: -4**, 43: +1**). "*I think we had a quick way to pollute the atmosphere with carbon. If there's a way to make money at it I'm sure we could fix it just as quickly"*, explains Russell Anderson (9: -3**).

Ocean fertilization has the potential to be a viable part of this solution and thus warrants exploration. "*I think we have the capability to successfully do ocean fertilization projects… Yeah I think we have the know-how and capability to really fix global issues, it's just nobody can get on the same page"*, remarked Brent Morton. While Russell Anderson responded, "*I would say collectively humans are probably smart enough… We send people to the moon, we can do other things. Technically speaking"* (43: +1**).

Either way, again echoing the positivism of the 'Developing Nature and the HSRC' and the 'Conserving Nature and the HSRC' frames, only science can tell us whether ocean fertilization is a good idea or not (4: +4**) and we won't know if ocean fertilization will work until we try (42: +5**). In the words of Participant Ryan Carr, "*the only way to determine the true impact [of ocean fertilization] is to do it more"*.

Participants that load significantly onto this factor additionally tend to employ positivist rhetoric, suspending the need for normative judgement in decision-making (36: 0) and asserting deficit-model logic that suggests contestation on ocean fertilization arises from a lack of public education (45: +1*).

Notably this epistemology resulted in many of these significantly loading participants dismissing statements within the Q-set that they considered 'irrational' or unduly emotive. "*My motivation for selecting these categories is more based upon fact than feelings"* explained Joe Newman. He continued, "*ocean fertilization is not so much about feelings and hoping that the earth will take care of us. It's about concrete action and concrete response to that action. It's not based so much on feelings. It's based on, you know, just hard clinical science and the facts. And the nice thing about facts is you can like a fact, or not like it, but the fact will exist. Facts don't give a shit if you like it or not"* (41: +1, 5: -5**, 13: -4**, 1: -4).

Because science holds the ultimate authority in this viewpoint, there is less need to democratise it. "*Not everyone needs to understand it*", Russell Anderson claimed, while Joe Newman suggested "*it is more important to do it [ocean fertilization], than to popularize it*" (12: -1, 27: 2).

In this viewpoint at the very least exploring and assessing the potential of ocean fertilization is within the remit of human capabilities (43: +1**). Captured in this same promissory rhetoric about the power of science (4: +4**), the barriers to making this assessment are held to be political – such as securing sufficient investment – rather than technical.

This viewpoint acknowledges that oceanic and climatic systems are complex and interconnected (3: +2), however again reflecting the 'Developing Nature and the HSRC' frame, for the most part scientists are deemed sufficiently proficient to be able to account for and manage the complexity of

these systems (16: -2**). Because we can figure out the impacts of ocean fertilization by "*go[ing] down the path slowly and carefully… learn[ing] every step of the way*" (Raymond Wallace) (10: -1), any risks of ocean fertilization can be monitored, assessed and managed.

Further if ocean fertilization appears to be having any negative impacts on the environment we can just stop doing it (25: +5**), so it is unlikely that ocean fertilization would have any disastrous consequences for humanity (30: -3**, 13: -4**).

Ocean fertilization then, is a practical response that may help us protect what we have left (22: +3**, 20: -1**). Participant Raymond Wallace explained, "*I think right now that's our best option for climate change. I don't see any other viable alternative. CO2 emissions, anthropogenic CO2 emissions are not going down. The human population is still in a growth period and I think it's delusional to think that by polluting less, that it's going to be possible to reverse climate change and global warming and harmful effects of anthropogenic CO2. I just don't think there's anyway that that's going to happen. I think what's required is an action item which is practical and it has a positive environmental impact".*

Far from continuing humanity's attempts to dominate and exploit nature (33: -2**), this viewpoint suggests that through ocean fertilization humans are responding to the needs of natural systems. "*I think people who support iron fertilization are among those who actually are looking at the data available and understanding the impact we are having on the Earth*", explained Ryan Carr (in response to statement 1: -4). Indeed to this factor ocean fertilization may be merely 'Restoring Nature'; accelerating the *recovery* of the health, integrity and sustainability of the climate system.

An interesting variant of this viewpoint was offered by both Haida participants that loaded significantly onto this factor, who further described ocean fertilization as 'giving back' to the environment in keeping with traditional Haida teachings (15: 0). "*Coming from a First Nation's perspective, we are stewards of the land. Us as First Nations have done a pretty damn good job of just taking what we need. We've always been taught like that… It's kind of what we did with ocean fertilization in a sense is we're just giving it what it need[s]"*, explained Brent Morton (41: +1, 37: +1).

For this viewpoint, iron in the ocean is a natural thing and ocean fertilization mimics the natural rhythms of nature (6: +2**). Reflecting both the 'Working with Nature and the HSRC' frame and the 'Restoring Nature and the HSRC' frame, ocean fertilization thus involves working with natural processes to restore a system to its more rightful, and even arguably 'more natural' state (37: +1). Ocean fertilization may therefore offer humans the opportunity to clear up some of the mess they've made, to help bring the Earth back to health (39: +3**) and even to take responsibility for the harm they have caused the environment (11: 0).

Whilst this viewpoint may describe ocean fertilization as 'restoring' natural systems, in contrast to Factor 1a this viewpoint does not subscribe to the idea of a natural order, best preserved through retraction of human influence (5: -5**, 8: -2**, 46: 0). Rather the idea that the human agency inherent to ocean fertilization damages some pristine natural state is rejected as hypocritical, given the scale of existing human influence over the global environment (40: -2**). "*I am all about managing. There are no natural systems left… we stopped leaving it alone quite some time ago*", explains Participant Russell Anderson (14: +3**).

Similarly the metaphor of humans 'playing God' through ocean fertilization that is very salient to Factor 1a, is rejected outright as irrational or illogical in Factor 1b (18: -4**). As Participant Ryan Carr explains, "*one could apply this statement [statement 18: "Ocean fertilization is humans trying to play God"] to almost anything we do, our agriculture, our medicine, our energy sources, etc.".* Instead this developmentalist-oriented viewpoint attests that we have already channelled human innovation and technological development in multiple ways in order to meet the demands of increasing resource pressures and to continue expanding the frontiers of modern society. Continuing to do this is fundamental to advancing the wellbeing of all (21: -3**) and to sustaining future populations (24: -2). Our lives would therefore be "*pretty mean spirited*" if a lot of these technological advances weren't allowed to happen (Participant Russell Anderson).

As seen in the 'Developing Nature and the HSRC' frame, in this viewpoint ocean fertilization is therefore held as not dissimilar to other resource management responses such as for example fertilizing our crops to meet the demands of a rapidly growing global population (26: +2**). "*Why should we look at our ocean any different than our farms*?" asked Brent Morton. "*I mean we use both in the same manner".* Further as Russell Anderson explains, humans acquiring the means of stewarding the planet through the challenge of climate change could have it's own beauty (38: +4**): "*It [ocean fertilization] would be elegant, just like a simple solution that would let us do all these things and exploit the economic development of fossil fuels, while not destroying our planet. Wouldn't that be nice*".

As this viewpoint sees it, we have already changed the climate system by emitting greenhouse gases, so trying to change it again with ocean fertilization is no different. At least this time we are doing it with our eyes open (14: +3**, 2: -1). Thus whilst there is some hesitation about unfettered management of natural systems writ large (46: 0), given that ocean fertilization only involves giving natural systems "*a little tweak*" (Participant Raymond Wallace), the intentionality of active human management, exercising the power of science and instrumental reason, means ocean fertilization is likely to be safer and more desirable than unmediated greenhouse gas emissions: "*Conscious, measured manipulation of ecosystems is preferable as it requires an entity or individual to take responsibility. The business as*

usual belief system understands that our actions are having an impact on natural systems but takes no responsibility… we need to better understand the natural system and learn to work with it for the betterment of all' (21: -3**) (Participant Rob Peters).

A more legitimate concern to this viewpoint however is that ocean fertilization could give humanity an excuse to carry on emitting greenhouse gases, meaning we miss the opportunity to transform our energy and economic systems; which is still fundamentally needed (34: -1**).

7.4 Interpretation of Factor 2

7.4.1 Factor 2: Climate and ocean systems are dynamic and interconnected. Ocean fertilization is very risky

Demographic and Statistical Profile – Factor 2 has an eigenvalue of 5.2 and explains 20% of the total study variance. Seven participants (Theresa Page, Gary Bennett, Lewis Fletcher, Max Cannon, Ross Poole, Lloyd Jones and Ruth Carter) are significantly associated with this factor at the 99% confidence level; five male and two female. None of these participants identify as ethnic Haida and none have ever been employees of the HSRC.

Factor 2 is significantly correlated with Factor 1a ($p < .01$), which could be taken as evidence that, in this study, three factors is too many. From this perspective Factor 1a and Factor 2 could just be seen as manifestations of the same viewpoint (Watts & Stenner, 2012: 141) and the Q-study could be argued to have captured just two, dialectically opposed, viewpoints within one bipolar factor.

Further weight is given to this argument through the observation that a further two sorts (those of Olivia James and Marianne Dunn) are confounded between Factors 1a and 2, loading significantly onto both factors at the 99% confidence interval, and a further one sort (that of Kelly Baker) is confounded between the two factors at the 98% confidence interval. Gary Bennett, a defining sort in Factor 2 at the 99% confidence interval, also loads significantly onto Factor 1a at the 98% confidence interval[140].

Despite this correlation, Factor 2 was retained as a unique factor in this study since different priorities and emphases found expression within the factor estimate and it was felt to capture a qualitatively distinct and meaningful point of view. Furthermore 20 out of the 47 statements in the Q-sort were 'distinguishing statements' for Factor 2, meaning that these statements were placed in a statistically different position ($p < .05$) on the Q-sort grid by participants that load onto this factor,

[140] Confounded sorts are typical in a Q-study. Cairns & Stirling (2014) for example similarly found 40% of their participants to load significantly onto more than one of their identified viewpoints. In this study these confounding sorts suggest that individuals may blend the perspectives captured in Factor 1a and Factor 2, or express them both at the same time.

to where participants that load on other factors have placed the same statement (Coogan & Herrington, 2011) (see Figure 7.2).

Adding this further dimension to the analysis, albeit in a correlated form, thereby allowed for important nuance to be drawn out of the data, which would have been hidden within a single bipolar factor solution. A two-factor solution additionally produced a result that explained a further 12% of the study variance. Remembering that Q-methodology is a way of organising, and reducing, viewpoints about an issue so that they are easier to understand and compare, this strategy was felt to make better and more meaningful sense of the data and to provide important additional insight.

Interpretation – At the heart of the Factor 2 viewpoint is the assumption that the Earth has a finite carrying capacity and that it cannot cope with the demands currently being placed on it (24: +3**). Anthropogenic climate change is indicative of this strained carrying capacity and of deficient climate governance (11: -3**). Echoing the 'climate emergency' rhetoric constructed in the 'Conserving Nature and the HSRC' frame (section 6.3.3), there is therefore an urgent need for remedial action. Participants that load significantly onto this viewpoint consequently tend to empathise with why proponents have come to express interest in ocean fertilization (29: -1). "*To suggest that the need for ocean fertilization has been over-exaggerated would suggest that climate change isn't that bad, or that we don't need solutions to climate change"*, explained Participant Ross Poole.

If we are to save the world from dangerous climate change, we need to act quickly this viewpoint attests (17: -1). However in this viewpoint ocean fertilization is not seen as a practical response that could help us protect what we have left (22: -1**), a step that could help humanity clear up some of the mess that we've made, to help bring the Earth back to health (39: -2*), or an opportunity for humans to grow up and take responsibility for the harm they have caused the environment (31: -5).

Reminiscent of the 'Conserving Nature and the HSRC' frame however, unlike for Factor 1a, this is not because ocean fertilization is in some way 'playing God' (18: -1**). Nor because ocean fertilization is continuing humanity's attempts to dominate and exploit nature (33: 0). Nor because using ocean fertilization to force change in our oceans will change us and we will lose our connection to the earth (2: -1). Nor because fiddling around with our environment through ocean fertilization goes against that which is held true and dear (5: 0**). Indeed, as in Factor 1b, participants that load significantly onto Factor 2 tend to be less committed to the idea of a 'pristine' natural order. "*We already do a lot of artificial things",* Ross Poole explained, for example. Ocean fertilization is also not morally wrong *per se* (23: -2**). In fact many of these ideas that emerged in Factor 1a are dismissed in Factor 2 as "*greenwashing*", "*airy fairy*" (Lewis Fletcher), or "*tree-hugger catch*

phrase[s]… [That are] not part of my consciousness" (Lloyd Jones) and are "*just so far out the left-field*" (Gary Bennett).

Resistance is also not driven by the belief that ocean fertilization would be conducive with efforts to oppress less powerful groups in society (12: -4) since, providing that everyone is given the opportunity to understand the science behind ocean fertilization rather than it being in a small number of hands (27: +3), in the words of Ruth Carter, this viewpoint concludes that "*people will rise up and say 'no'*".

Instead the idea that a 'quick-fix' to climate change can be found in ocean fertilization is regarded as deeply suspicious (32: +4). "*It didn't happen quick and its not going to end quick*", Participant Gary Bennett responded. Factor 2 therefore calls for a refocusing on the structural reasons for why the planet 'is being stretched to its limit' (34: +2, 24: +3**). This sentiment was perhaps best surmised by Marianne Dunn[141] who explained, "*if something like ocean fertilization is seen to be an instant 'fix' to our very complicated social-ecological systems throughout the world, humanity may feel as though we can continue with our growing oil and gas culture and economy instead of looking to change our relationship with each other and with the earth".*

Ocean fertilization could therefore give humanity an excuse to carry on emitting greenhouse gases, meaning we miss the opportunity to transform our energy and economic systems (34: +2). And rather than focusing on the roots of the problem, ocean fertilization is going to just add to "*flawed*" carbon markets wherein "*organisations with money just pay [to continue] polluting*" (Ross Poole) (7: 0**).

This would be especially true if ocean fertilization was done by private companies (9: +3**) since among such agents "*we know it's greed that prevails*" Participant Lewis Fletcher explains; meaning ocean fertilization would be unlikely to be used for the betterment of all (21: +2*). "*I think I'd have more faith if the Government of Canada and Fisheries, and whatever other bureau's, said 'we are going to do what's best for the world. And we'll do it at public expense'",* Participant Ruth Carter suggested. Reflecting findings in the 'Conserving Nature and the HSRC' frame, other participants that loaded onto this factor responded similarly. "*I would prefer governments to do it. Assuming [there is] some global agreement, based on good science. Hopefully it [the science] is correct…*" (Participant Lloyd Jones) (9: +3**, 11: -3**).

Other significantly loading participants reiterated this idea, expressed by Lloyd Jones, that a condition of exploring ocean fertilization would be that it had a basis of 'sound science' as a reliable guide to policy. Research must also be able to foresee the impacts of such an intervention (4: +1**)

[141] NB. Participant 25 is significantly (p <0.01) confounded between Factor 1a and 2, but loads particularly heavily onto Factor 2. This extract is nevertheless included within Factor 2 given that qualitatively it was felt to best articulate this Factor 2 sentiment.

(c.f. Macnaghten & Szerszynski, 2013): "*How else can they judge it or make a decision on it unless they've got scientific data?",* Participant Theresa Page asked.

Yet as in the 'Conserving Nature and the HSRC' frame this viewpoint also conveyed disbelief that such conditions would ever be plausible (4: +1**) (c.f. Macnaghten & Szerszynski, 2013). We don't have our "*eyes open*" to the effects of such an intervention (14: -2). "*The system is too big. There are some things that we just can't understand. We might in a million years*", Participant Lloyd Jones explained (43: -4). Natural systems are so interconnected and complex that every time humans try to affect them in one way, something else is affected too (3: +5**). "*Whatever we do on one hand impacts us in another way further down the line"*, Participant Lewis Fletcher responded to explain why making predictions is very difficult, or impossible, and why action may set in way a chain of reactions and runaway impacts (25: -4**) which could have grievous consequences for humanity (30: +2*). "*Its like dropping a pebble into a pond and you've got a ripple going out… everything will be affected. And this ocean fertilization thing, you can stop doing it but you can't negate what's already been done"* (Participant Theresa Page).

Effectively in Factor 2 there is no beauty to be found in the idea that through ocean fertilization humans may be able to acquire the means of stewarding the planet through the challenge of climate change (38: -3). And ocean fertilization should not be pursued (19: -5), because there are "*so many possibilities of disaster and so many possibilities of annihilation*" (Participant Ruth Carter).

An allied dimension to this viewpoint is resistance to ocean fertilization due to a more general discomfort with the idea of 'managing' natural systems at this scale (46: +3**, 16: 0). This sentiment has no strong link with the concerns of karmic retribution identified in Factor 1a (13: +1**), but rather, as discussed above, is based on a cautious and sceptical interpretation of technological capacity. Participant Lloyd Jones spelt this out: "*I don't think the universe will fight back. The system will just do what it does. Fighting back implies that it knows what its doing. It just follows natural consequences. Trouble is we can't do the math, it's too complicated*".

This sentiment was widely contended by participants that loaded significantly onto this factor. "*We can't manage them [natural systems]*", Participant Max Cannon attested. "*Our track record is so horribly poor… You know, you do one thing, it's going to change something else. We're not even close to being smart enough to figure out all those different inputs into you know Mother Nature's system*". Participant Theresa Page elaborated on this viewpoint: "*Looking at what humans have done with their earth already, extracting all of the resources out of the earth… overfishing, over-cultivating. [These] all indicate that we are not smart enough to embark on another addition to our natural environment, another change*". Ocean fertilization, Factor 2 concludes, is therefore likely to just compound the challenges we face. Or in the words of Participant Gary Bennett, it is "*put[ting] more dung on the heap*".

This viewpoint emphasizes ecological relationships (3: +5**) and the interconnectedness and interdependencies between human and non-human worlds (37: +2, 15: +2). "*We live in an ecology. We live in a world where there's an ecology where we all have our part to play"*, Participant Lewis Fletcher explained. Thus this viewpoint attests that if you take care of the Earth, it is going to take care of you (41: +4*). But since no technological fix, ocean fertilization included, will get us around the fact that the earth cannot cope with the burden of demands currently placed on it (24: +3**), in Factor 2 'taking care' of the Earth denotes more restricted role for human agency than Factor 1b. Indeed it advocates an approach oriented towards withdrawing human influence (8: +1), and avoiding "*over management of natural resources*" (Participant Theresa Page). "*I don't feel ocean fertilization is taking care of the earth. Taking care of it would mean keeping it clean and not polluting it with anything*" Participant Theresa Page explains.

Rather than fertilizing the oceans humans need to be willing to change and to learn to live within the Earth's limits (28: +5**), using more simple and precise means (20: +4), which prioritise reduced consumption – "*don't take any more than the earth can provide for you"*, Participant Gary Bennett insisted. This should be pursued alongside cautious technological innovation, employing as far as possible approaches with "*known impacts*" (Participant Lewis Fletcher) (26: -3). "*Contained*" (encapsulated) approaches may be prioritised (Participant Max Cannon). Or approaches that 'work with natural systems' may be perceived as preferable (c.f. 'Working with Nature and the HSRC' frames). But any approach should be approached slowly and cautiously. "*I think we need to maybe do it [respond to climate change] quickly but small. Because we don't know the outcomes. I think the bigger the experiment if you will, the more danger we have of making problems that we don't anticipate… There's lots of things that we can do before we have to do ocean fertilization and most of them will come from conservation… Changing our behaviours in that way*" (Participant Max Cannon) (17: -1).

Again echoing the 'Conserving Nature and the HSRC' frame, several participants that load significantly onto this factor do however suggest that some of their rationales may break down under certain climate futures and that, depending on the severity of future climate risks, unbridled resistance to ocean fertilization may be 'naïve'. Participant Lewis Fletcher offered a salient summary of this viewpoint: "*All of these things [geoengineering proposals] represent tremendous risks okay. And if your mindset is that we're at the precipice well then maybe you have to take those risks. I don't think we're at the precipice now. So why don't we turn all of our energies into eliminating or substantially, significantly reducing fossil fuel use. We have enough alternative energy opportunities out there. We're going to have to learn to live with less energy… we may not have cars to drive around in anymore… Maybe there has to be more urbanisation".*

7.5 Comparing and Contrasting the Viewpoints

Q has been held to be a valuable tool for exploring contested debates because it is able to help draw out differences in accounts of a problem, and thus can be used to focus the debate (Eden et al., 2005; Steelman & Maguire, 1999). In keeping with this objective the factor interpretations offered have drawn out many differences in the priorities expressed by the factors. Figure 7.4 above offers a useful review of the most contested Q-statements and these can be fairly easily traced back to the factor interpretations offered above. Factor 1a for example offers an interpretation of ocean fertilization which sees humans overstepping their place in the natural order and intruding into realms in which they don't belong (18: +5**). Yet for Factor 1b and Factor 2, this type of reasoning holds little credibility. Factor 1b instead prefers to rationalise exploration of ocean fertilization as part of a wider socio-technical project of human development, in which only science and instrumental reasoning can connote the value of ocean fertilization (42: +5**). Factor 2 meanwhile positions ocean fertilization within storylines about the complexities of natural systems, suggesting optimal solutions to emerge from reflection on the limits of human capacity (32: +4) and of natural systems themselves (28: +5**).

Figure 7.4 Most contested statements: based upon variance across factor z-scores

Q-Statement	Factor array value		
	1a	1b	2
18. Ocean fertilization is humans trying to play God.	5**	-4**	-1**
5. Fiddling around with our environment through ocean fertilization goes against everything that I hold as true and dear.	4**	-5**	0**
23. Ocean fertilization is morally wrong	4**	-5**	-2**
42. We won't know if ocean fertilization will work until we try.	-5**	5**	-1**
13. If we try to manipulate nature in this arrogant way, the universe will fight back and humans will eventually pay the price.	5**	-4**	1**
19. If you think you may have a solution to climate change, then you are morally obligated to pursue it. Ocean fertilization is a good example of this.	-2	3**	-5
39. Ocean fertilization might help us clear up some of the mess we've made, to help bring the Earth back to health.	-4*	3**	-2*

What has been less well highlighted in the analysis so far however is that as shown in Figure 7.5 below there are also a number of statements that were ranked similarly by participants that loaded

onto all factors; suggesting these statements to be less controversial among the participants in the study that loaded onto one of these factors. Brown (1980) cautioned against over-interpreting apparent consensus statements, noting that their seemingly similar rankings may conceal differences in understandings of the statements across factors. But these items are worth some reflection for any opportunities that they may present for constructive dialogue between perhaps non-consensual, but non-confrontational aspects of participants accounts (Webler et al., 2009).

Figure 7.5 Strongest consensus statements: based upon variance across factor z-scores

Q-Statement	Factor array value		
	1a	1b	2
37. My feelings on ocean fertilization are shaped by an understanding that human and non-human worlds are entangled. Trying to separate them is meaningless.	1	1	2
15. My feelings on ocean fertilization are born from a feeling of connection to the earth and to other forms of life.	1	0	2
35. I'm worried that people will get greedy, and rush ahead with ocean fertilization.	2	0	1
12. Ocean fertilization could easily become an instrument conducive with efforts to oppress less powerful groups in society.	-1	-1	-4
41. My feelings on ocean fertilization are shaped by the understanding that if you take care of the Earth, it is going to take care of you.	2	1	4*
36. Decision-making on ocean fertilization needs to come from a societal conversation about morality and human values.	3	0	1
27. I hope that everyone is given the opportunity to understand the science behind ocean fertilization, rather than it being in a small number of hands.	0*	2	3

As shown in Figure 7.5, Statement 37 – 'my feelings on ocean fertilization are shaped by an understanding that human and non-human worlds are entangled. Trying to separate them is meaningless' – was the statement ranked most similarly by each factor. All expressed moderate acceptance of this statement although as Brown (1980) advised, different factors offered notably different accounts of the meaning of this statement. For participants loading significantly onto Factor 1a, Statement 37 spoke to a sense of interconnectedness between human, non-human and at

times supernatural worlds, premised on an account of reverence for the natural world (13: +5**) and an inherent natural order (18: +5**). While for participants loading significantly onto Factor 1b and Factor 2, this statement had more resonance with literatures that have labelled the current era the 'anthropocene' (e.g. Crutzen, 2002a, 2002b; Steffen et al., 2007); an age in which humans have become the dominant force of change on Earth and in which human and non-human worlds are linked in a common trajectory of mutual dependence and self-actualisation.

Echoing an observation explicated in chapter 6, through these rationales the accounts of ocean fertilization offered by all factors appeared to be broadly shaped by a general sense of responsibility for ensuring the health and wellbeing of the environment (e.g. see statement 41), and often reflect a feeling of connection to and dependence on the earth and other forms of life (e.g. see statement 15)[142]. This may be the extent of that which can meaningfully be said about the continuity to emerge from these accounts, since clearly from here descriptions of the role that ocean fertilization could play in such stewardship largely diverged. Yet that participants typically described a sense of entangled interdependence between themselves and their environment and that this imbued most participants with a strong commitment to their particular prescription for environmental protection, is perhaps an encouraging area of consensus that should not be overlooked. When analyzing ocean fertilization policy preferences, it may be that for many in some ways the 'end-goal' looks quite similar, even if the path to reaching that goal looks very different.

7.6 Reflection on the Method and Limitations of the Q-Sort

Participants generally reacted well to the Q-statements and reported feeling able to effectively represent their perspective through the Q-set provided. All participants were offered the chance to supplement the Q-set and to identify omissions. One participant suggested more attention could have been given to governance issues within the Q set, although this was largely outside of the scope of the research[143]. However participants typically reported finding the corpus of statements suitably comprehensive: "*I think you covered it all pretty good*" (Participant Noel Townsend), "*I think you may have covered it. I can't think of anything*" (Participant Jan Fields), "*there might be something [missing] but I can't think of anything*" (Participant Ross Poole) were typical responses.

It is of course possible that some of these reactions were driven in part by a desire to please and support me. This is especially likely since given the immersive, ethnographic nature of the overall research design, by the time the Q-sorts were being conducted many participants had become acquaintances or even friends. Further since this question tended to come at the end of a lengthy

[142] This finding reinforces the assertion that these factors must not be seen to be exhaustive since the more fatalistic approach to understanding nature seen in the 'Living with Nature' frame in chapter 6 does not convey such a sense of human responsibility for the health and wellbeing of the environment.
[143] This perhaps suggests that the Q-study that explored geoengineering governance conducted by Cairns & Stirling (2014) could be usefully extended to encompass public, as well as expert participation.

engagement with the sorting process, it is also possible that some participants were just simply too 'burnt out' to engage with this line of questioning.

Whilst completing their sorts several participants expressed concern that the forced distribution of the sorting matrix was unduly restrictive. In 1980 Brown contested this critique of Q suggesting that sorting a Q-set encompassing 33 statements onto a 9-point fixed distribution actually offered participants "roughly 11 times as many [sorting] options… as there are people in the world" (Brown, 1980: 267). Yet while Brown may suggest this feeling of restriction to be statistically misguided, it was nevertheless very real to some participants' lived experience of the sorting process.

Most notably three participants described this forced distribution of relative judgments as being at odds with their way of viewing the world: "*I don't think that way"*, Participant Marlene Hawkins explained. "*Things are black and white for me. Grey is bullshit"*. Participant Harry Doyle echoed this sentiment: "*I'm pretty adamant about what I agree with and what I disagree with. There isn't a lot of grey areas in my thought process… I don't really have much of a scale in the way I think. So I'm at a loss here to try and put a higher value on some of them than the others".*

I tried to encourage another participant – Valerie Collins – who adopted a similar stance to complete the sort by emphasizing firstly the relative rather than absolute nature of the sorting process and secondly that the method was being employed in a more interpretative manner and therefore the exact position of the statements was not the end point of the analysis. However for this participant there was an irreconcilable ontological clash between her way of viewing the world and the design of the method, which meant that she was unwilling to differentiate between the 26 statements that she had grouped in category 1 under the heading of "least like I think". "*Morality is not relative*", was her rationale. *"[Asking me to compare these statements is] like asking whether it's more moral to murder someone by shooting them with a gun or by stabbing them with a knife"*. This particular interview resulted in productive discussions about the statements, some of which was preserved as qualitative data, but ultimately the Q study itself was not able to represent this participants' viewpoint.

There were other factors that limited participation in the Q-sort. The sample in phase one of the research included participants with a wide range of formal education qualifications. Some hadn't finished primary school, while others held, or were working towards, doctorates. Diversity in all its forms was highly desirable for exploring pluralism in the debate, however participation in the Q-

sort phase of the research was more constrained by the requirement that participants be literate. This prevented at least one, otherwise willing, participant from completing the Q-sort exercise[144].

At least one other participant – Jim Ross – felt unable to participate in the study because the prospect of doing so was too stressful. A key figure in the Haida Salmon Restoration Corporation, this participant emphasized the backlash that he and his colleagues had faced as a result of the project. Although he was willing to participate in the interview phase of the research, he appeared to feel that through the more structured Q-sort exercise he would be "*under pressure*" to react without having time to "*think about it*" and that he might be judged and scrutinised as a result. Ethical considerations meant that this point was not forced and this respondent did not complete the Q-sort.

Other features of the exercise worthy of brief reflection include the fact that participants conducted the sorting process with varying diligence and conscientiousness. None appeared so rushed or ill-considered that I lost confidence in the sort and felt the need to discard the data (see Webler et al., 2009). But undoubtedly some scrutinised the exact placement of the cards more meticulously than others.

Some participants also found it difficult to differentiate between those statements that they felt less strongly about, and to populate the middle of the distribution. "*I can't say one over the other, for any of these others*" Participant Gary Bennett commented. While Participant Lewis Fletcher suggested that "*what goes on in the middle is just a bit hap-hazard*". Some participants also reported finding the exercise challenging. "*I'm trying to keep ten or twelve ideas in the back of my mind. My poor little brain"*, Participant Raymond Wallace described. Nevertheless post-sort interviews helped ensure that participants had fully reflected on their item configurations and most participants appeared to feel that overall they had been able to meaningfully represent their perspective through the exercise.

A further noteworthy limitation of Q pertains to its temporally frozen nature, whereby it artificially holds an individuals' point of view constant for examination and comparison (Coogan & Herrington, 2011; Eden et al., 2005). No claim can be made that the representations of viewpoints are in any way stable or consistent within individuals over time. Understood in this way Q-methodology is compatible with other critical and broadly constructionist paradigmatic commitments, discussed in section 3.6, which resist the idea of stable psychological features such as 'attitudes' and the "assumption that a given participant is capable of expressing only one coherent

[144] I contemplated attempting to facilitate this particular participant's Q-sort process by reading the statements to the participant. However being able to compare and visually engage with many ideas at the same time is generally held to be key to the methods success (Watts & Stenner, 2012), so ultimately I decided against this strategy. Although the participant did not complete the sort, they did engage in further informal discussions about the topic.

viewpoint on an issue" (Watts & Stenner, 2005a: 85-86). The factors described in this study must therefore be seen as contextually and temporally contingent. All that can truly be claimed in this research is that through the Q-sort exercise the study participants *did* construct accounts, which were then interpreted in this way by me. It is a plausible assumption however that most participants would likely demonstrate a degree of consistency in their expressed viewpoint if asked to repeat the exercise over time (Watts & Stenner, 2005a).

The value of Q-methodology lies in the opportunity to explore shared meanings and to open these to critical reflection and facilitate dialogue. Q-methodology is a novel way of approaching this task, but by the nature of seeking to draw out that which responses held in common, much of what made responses unique is lost. Further, as shown in Figure 7.1, a number of participants sorts (those of Ronnie Stevenson, Chris Shaw, Ben Watson, Kelly Baker and Jan Fields) did not load significantly onto any of the factors identified in this study, suggesting that this study did not capture their perspectives in a meaningful way. While the Q-sort has done the job it was intended to do, awareness of the way in which Q may silence minority perspectives is important if we are to avoid further marginalizing alternative voices.

Chapter 8: Discussion and Conclusions

8.1 Returning to the Research Questions

This thesis has contributed to the existing social science literature on public perceptions of geoengineering that has explored and analyzed perceptions of geoengineering in the context of wider beliefs, values and assumptions that people construct about the world around them (Bellamy & Hulme, 2011; Corner et al., 2013; Macnaghten & Szeszynski, 2013). Developing existing theoretical literatures (Clingerman, 2014; Galarraga & Szerszynski, 2012; Hulme, 2014), this thesis has argued that interpretations of ocean fertilization entail what Clingerman (2014: 10) labels an implicit "anthropology". I have argued that different interpretations of the desirability and feasibility of the HSRC's ocean fertilization project invoke different implicit interpretations about the nature of 'nature', of technology and of the appropriate relationship between 'human' and 'non-human' worlds. These interpretations, I have argued, also construct different ideas about what it means to be human, about the way in which humans can attain knowledge of natural systems and about the 'natural' or 'artificial' quality of technological mediation of the environment.

I believe the methods and case study chosen in this research have proven to be fruitful means of developing a situated interpretation of my research questions. Using the five dimensions of Hedlund-de Witt's (e.g. 2012) Integrative Worldviews Framework as a lens to scrutinise the case study discourse resulted in reflection on many of the aspects of 'environmental attitudes' that have been facilitated by other proposed 'measures' of these 'attitudes'. Ideas of 'preservation' and 'utilization' (c.f. Milfont & Duckitt, 2004), 'ecocentrism' and 'anthropocentrism' (c.f. Thompson & Barton, 1994), techno-optimism and techno-pessimism (c.f. Cotgrove, 1982), the stability of nature (c.f. Thompson et al., 1990) and different intrinsic, instrumental and spiritual values to nature (c.f. Chandler & Dreger, 1993), for example, all play out in the frames proposed in chapter 6 and the factors interpreted in chapter 7. Yet the IWF lens did not depend on attempting to 'measure' these dimensions of 'environmental attitudes' according to single, pre-defined, binary distinctions (Hedlund-de Witt, 2013a). Nor did it intentionally impose or limit analysis to the exploration of existing frameworks for exploring 'views of nature' (e.g. Bellamy & Hulme, 2011). Instead, it left me as a researcher as free and open as possible to explore and react to my case study data, and it allowed me to develop an analysis of the way in which different ideas, 'measured' by these earlier psychometric approaches to evaluating 'environmental attitudes', may emerge in more nuanced ways, or be conflated and integrated with other cultural meanings by participants (c.f Hedlund-de Witt, 2013a).

The frames 'Mastering Nature and the HSRC', 'Developing Nature and the HSRC', 'Conserving Nature and the HSRC', 'Restoring Nature and the HSRC', 'Preserving Nature and the HSRC',

'Working with Nature and the HSRC' and 'Living with Nature and the HSRC' accordingly designed more nuanced interpretations about the kinds of 'nature', and indeed the kinds of 'human', that might be brought into being through the geoengineering ambitions of the HSRC. To echo Galarraga & Szerszynski (2012), each frame offered diverse interpretations about the kind of 'makers' that humans may become through ocean fertilization and of how these different forms of 'making' might shape our evolving relationship with nature. These frames offer diverse accounts of real and preferred relationships between human and non-human worlds, helping to illustrate the kinds of implicit contested ontological, epistemological and axiological assumptions that may be interpreted from participants' discourse about the HSRC. They do not however all map neatly into support or resistance for the geoengineering ambitions of the HSRC, or seemingly into support or resistance for ocean fertilization more generally.

The frame analysis in chapter 6 also shaped the development of a Q-Methodology concourse to pursue another methodological lens through which to look at the data. Much as conventional factor analysis searches for unobserved latent variables to explain variability among observed, correlated variables, Q-Methodology provided a means of structuring an interpretation of some of the ways in which deeper forms of shared meaning may have shaped some of the diversity across the ways in which participants constructed and articulated views and preferences. In this way the method respected the conceptual ground of the worldviews literature reviewed in chapter 3 that positions 'worldviews' as the deeper philosophical foundational structures that underlie other 'subordinate' knowledge and symbolic frameworks that give meaning to human existence (Hedlund-de Witt, 2013a; Laughlin, 2007; Koltko-Rivera, 2004; Olsen et al., 1992).

By developing typologies to model "attitudes of mind held in common" by participants (Stephenson, 1965: 281), in line with the social constructionist tradition of using Q-Methodology as a form of discourse analysis (e.g. Stainton Rogers, 1995), the Q-analysis offered an interpretation of major "commonly held or shared viewpoints" about ocean fertilization, constructed and represented by participants through their sorting of the Q-statements (Watts & Stenner, 2012: 43). Further Q considered patterns of association between the entire configuration of Q-statements produced by participants. Thus, again echoing the conceptual ground of the worldviews literature which describes worldviews as "overarching systems of meaning and meaning-making" (Hedlund-de Witt, 2012: 80), the method lent itself to interpreting clusters of shared meaning holistically, by exploring how interpretations of different ontological, epistemological and axiological assumptions may be integrated through the factors. Interpretative engagement with Q-Methodology additionally offered the opportunity to triangulate and refine the frame analysis in phase one of the research.

The Q-factors lead to the interpretation of 3 'key viewpoints' on the desirability and feasibility of exploring the 'geoengineering' potential of ocean fertilization. In response to my research questions, analysis explored the ways in which different boundaries between 'natural' and 'human' worlds could be interpreted and re-interpreted from these factors. It also explored the ways in which these factors afforded different forms of 'Nature' value and suggested fundamentally different ways of conceiving and relating to the concepts of 'nature' and 'naturalness'. The factor interpretations constructed diverse accounts of the role and purpose of the human being and offered an interpretation of how different forms of knowledge, including secular, spiritual and religious beliefs, shape these interpretations and gain legitimacy through this debate. A summary interpretation of these three 'key viewpoints' is offered in Figure 8.1 below, according to the five dimensions of Hedlund-de Witt's (e.g. Hedlund-de Witt & Hedlund-de Witt, 2015, *in press*) Integrative Worldviews Framework.

Figure 8.1: Implicit Ontological, Epistemological and Axiological Assumptions about the Nature of 'Nature' and Human Agency Tentatively Interpreted from the Q-Methodology Factors, Structured According to the Five Dimensions of the "Integrative Worldviews Framework"

	Factor 1a: Ocean fertilization is morally wrong. We need to preserve the natural order.	**Factor 1b: Ocean fertilization should be urgently explored. Through science we can respond to the challenges of climate change**	**Factor 2: Climate and ocean systems are dynamic and interconnected. Ocean fertilization is very risky**
Ontology	Nature possesses a meaningful inherent natural order with its own internal logic or even agency (e.g. God's Creation / Mother Earth). A price may be paid for attempting to interfere in this order. *e.g. Ocean fertilization is humans trying to play God (Statement 18).*	A mechanistic and secular cosmology. Nature is a resource that should be developed to meet the needs of humanity. Apparent planetary limits or constraints can be overcome by technology. *e.g. "[Ocean fertilization] would be elegant, just like a simple solution that would let us do all these things and exploit the economic development of fossil fuels, while not destroying our planet. Wouldn't that be nice" (Participant Russell Anderson).*	Natural systems are interconnected, dynamic and complex. Entangled relationships between human and natural systems are emphasized and shaped by a secular cosmology and an understanding of inherent natural limits and ecological interdependencies. e.g. *Rather than fertilizing the oceans, humans need to learn to live within the Earth's limits (statement 28).*
Epistemology	Different forms of vernacular, cultural, spiritual, moral and experiential knowledge are stressed, including metaphysical and religious knowledge. These forms of knowledge should guide decision-making. *e.g. Ocean fertilization is morally wrong (statement 23).*	The universe is explained through physical laws and reality is objectively knowable. Science can diagnose and evaluate problems. (Post)positivist empiricism and instrumental reasoning should guide decision making. Education will resolve contestation. *e.g. Only science can tell us whether ocean fertilization is a good idea or not (statement 4).*	Pragmatic/post-positivist orientation offering cautious and sceptical interpretation of technological capacity that emphasizes uncertainties and risks and the finitude of human knowledge in the face of complex and interconnected systems. *e.g. Trouble is we can't do the math, it's too complicated (Participant Lloyd Jones).*
Axiology	Intrinsic, deep ecology values are emphasized and humility, sacrifice and respect for tradition and the 'integrity' of natural systems are all advocated.	Material value orientation emphasizing progress, achievement, innovation, opportunity and the libertarian principle of protecting individual freedoms.	Intrinsic and extrinsic values of nature emphasized. Seeks to reconcile conservation goals of nature with its many other values. Social justice concerns highlighted.

	e.g. Fiddling around with our environment through ocean fertilization goes against everything that I hold as true and dear (Q-statement 5).	*e.g. "I am not a screaming crying preservationist and conservationist… [what I want to know is] how do we make this planet work for us, and what are the ecosystem services" (Participant Rob Peters).*	*e.g. Ocean fertilization is unlikely to be used for the betterment of all (statement 21).*
Anthropology	Humanity is subject to a pre-defined role in the natural order. Overstepping this role brings humans into a fundamentally unnatural relationship with nature. Humanity may disrupt nature's integrity or be subject to 'Nature's' impulses and wrath. *e.g. "Make people return to the fact that they are only part of the earth… we are not greater" (Participant Joanna Cook).*	Active 'management' of natural systems, exercising the power of science and instrumental reason, offers the route to greater human wellbeing and sustainable relationships with natural systems. *e.g. It's too late to just start treading more lightly and polluting less. We need ideas like ocean fertilization to undo some of the harm we've already caused (statement 47).*	Humans are part of complex, interconnected and dynamic natural systems. When humans try to affect change in one part of the system, something else is affected too. Thus humanity is in a cautious relationship with nature. *e.g. "Whatever we do on one hand impacts us in another way further down the line" (Participant Lewis Fletcher).*
Societal Vision	Humans have fallen from grace and need to seek salvation through humility and respect for the natural order. This may include forgoing consumption and material desires and restoring and preserving traditional relationships. *e.g. Rather than fertilizing the oceans, humans need to learn to live within the Earth's limits.*	Innovation in science and technology is the pathway to social progress and to solving environmental challenges. Barriers to innovations are political rather than technical. Markets must be allowed to perform their correcting role. *e.g. Ocean fertilization is not dissimilar from the principle of fertilizing our crops, to meet the demands of a rapidly growing global population (statement 26).*	Economic and energy systems need to be fundamentally restructured to align with the Earth's carrying capacity. Careful human management of natural systems is not reprehensible per se but this techno-cautious position emphasizes risks and uncertainties and questions 'effectiveness' and 'feasibility'. Regulation and public consultation is important to prevent exploitation by vested interests. *e.g. We need to look for more civilized and precise solutions to climate change than ocean fertilization (statement 20).*

Q-Methodology further abstracts participant's meanings and inherently constrains socio-cultural relativism. The limitations of this analysis have therefore been stressed, and will continue to be so (see especially section 4.1.1). Nevertheless, I believe the factor interpretations offer useful orienting heuristics that help to conceptualise shared meanings and draw out some of the key differences between perspectives on ocean fertilization interpreted from this case study. What's more, this method was able to draw out these differences and to situate perspectives within the context of others, without bringing actors together into a potentially very emotional and highly charged focus group setting (Danielson et al., 2009). In this way Q-Methodology served as an innovative mechanism for putting different geoengineering "stories in conversation" as Buck (2010: 9) proposed was essential for meaningful public participation.

These factor heuristics have been particularly successful at allowing more subtle distinctions between 'ideal-typical' viewpoints to be interpreted. To offer one example of how such subtleties have emerged from the analysis, phase one of the research suggested that participants frequently sought to integrate scientific concepts and rationality into their own meaning-making about the geoengineering ambitions of the HSRC. A general role for 'scientific enquiry' in decision-making about geoengineering was accordingly described by each of the ideal-typical factor heuristics, yet the nature of that role varied significantly. For Factor 1b, empirical enquiry offers humans the ability to observe, measure and record the impacts of ocean fertilization on the marine and climatic systems and the factor describes the scientific method as the *only* route through which reliable knowledge about the desirability and feasibility of ocean fertilization can be attained. Factor 2 meanwhile offers a more cautious and skeptical interpretation of the potential of the scientific method, while Factor 1a sees scientific knowledge as one form of truth among many and positions science alongside different forms of vernacular, cultural, spiritual, moral and experiential knowledge.

8.2 A Situated Engagement with Perceptions of 'Geoengineering'

In a literature that has previously been dependent upon more abstract forms of public engagement with the idea of geoengineering (see section 3.8), through this case study I have had a very novel opportunity to anchor a study of public perceptions of 'geoengineering' within a situated physical, political, cultural, economic and social context and within notions of place and identity. This research has therefore been able to make a particularly unique contribution to existing literatures as, in keeping with geographical traditions, this situated engagement has allowed my analysis to retain meaningful characteristics of real life circumstances. The case study proved a particularly fruitful site from which to develop analysis of crucial questions about geoengineering (inter alia the meaning of nature, human self-understanding and the human role in nature), given that debate about the desirability and feasibility of the 'geoengineering' ambitions of the HSRC embroiled a

particularly diverse group of stakeholders and actors. Indeed, this is the first empirical study of public perceptions of geoengineering that is known to the author to consult Indigenous people.

Such situated engagement with discourse about the desirability and feasibility of the HSRC's ocean fertilization project revealed that for my study participants it is not possible to meaningfully understand 'geoengineering' in Haida Gwaii without reference to local specificities and attachments to the landscape (c.f. Jasanoff, 2010). Russ George and his off-island colleagues at *Planktos Science* found an entry point to bring the idea of 'geoengineering' to the village of Old Massett through a unique confluence of various social, political, cultural and environmental circumstances.

Local vulnerability to anthropogenic climate change as well as social vulnerabilities such as ongoing Indigenous disadvantage were key motivators for the project. An extensive local history of natural resource extraction and depletion, as well as local familiarity with pursuing carbon credits in exchange for environmental protection, were influential to its reception. Reactions to the project also tapped into the ongoing desire to rekindle greater Haida cultural identity, political autonomy and even national sovereignty, following a painful history of European colonial atrocities and the dispossession of Haida rights, language and traditions. In a similar vein debate about the HSRC became embroiled in enduring issues of land rights and contestation about resource access and permits and about the development and permissibility of different forms of local industry. Additionally, participants often made sense of the HSRC project through deep spiritual and practical relationships to the land and sea, taught in Haida oral history. Most visibly these included Haida cultural and spiritual affiliations with local salmon runs and local dependence on natural resources for livelihoods and nutrition. People similarly often understood the HSRC project through earlier experiences with the Canadian federal government and through a history of outsiders attempting to speak for Indigenous people.

Geography and place were centrally implicated in how people understood the HSRC project. Geographic isolation and the high cost of living, for example, shaped interpretations. So too did recent geophysical events, such as Earthquakes and the 2008 eruption of Kasatochi volcano. Natural abundance of local biodiversity and recent fluctuations in local salmon runs were other influential factors shaping meaning-making about the project. So too were the island's experiences with non-native introduced species and local concerns about the Enbridge pipeline proposal to bring oil tankers to surrounding waters. National debates about the Alberta Tar Sands and about the Canadian government's participation in global climate governance structures also visibly shaped the reception of the project: A finding which emphasized the interrelatedness of people, knowledges and places, that led to the 'cosmopolitan' approach to defining the case study field site (see section 3.8.2).

As has been illustrated, participants in this case study therefore did not speak about 'geoengineering' in isolation from the textures of their daily life and their wider experiences and perspectives on the world. Instead discourse about the desirability and feasibility of the 'geoengineering' ambitions of the HSRC speaks to different notions of identity, place, ethnicity and community. This case study therefore suggests that 'geoengineering' will always be performed and interpreted through contextually specific meanings and such local particularities as geography, people, practices, governance structures and representations.

The way in which discourses and frames were hermeneutically 'uncovered' in this study therefore remained contextually specific and idiosyncratic. And the precise 'ways of talking' about 'geoengineering' and the specific cultural features of 'geoengineering' discourse were inexorably unique to this case study. Through discourse about the 'geoengineering' ambitions of the HSRC this thesis has, however, also traced, supplemented and developed discourses, frames, storylines, explanations, phrases, metaphors, themes, images, tropes, exemplars, lexical choices, policy positions and evaluations that are familiar to earlier geoengineering social science literatures.

Cairns & Stirling's (2014: 31) "We are the Planetary Maintenance Engineers" factor, constructed from the Q-sorts of a sample of prominent geoengineering actors from academia, industry, government, civil society and the media, offers one illustrative example of this dynamic. The Q-statements that defined this Q-factor drew upon abstracted global scientific representations of climate change, such as rising average global temperatures, to suggest that the climate system is in an unprecedented and dire state of emergency and thus to authorise the exploration of geoengineering technologies. Whereas in this case study of the HSRC's ocean fertilization experiment, such an 'argument from catastrophe' (c.f. Buck, 2013a, Nerlich & Jaspal, 2012; Scholte et al., 2013), at times invoked similar ontological, epistemological and axiological assumptions about the stability of natural systems, about the types of knowledge that can be considered valid and about responsibilities and capabilities of human beings in relation to the natural world. But in this case study, although participants often integrated such larger scales of scientific representation into their meaning-making, these were typically situated in and reinterpreted through local experience. Participant Jim Ross illustrated this dynamic for example. *"People are unsure whether to take the risk [with ocean fertilization]… But they've got nothing to risk"* he explained. *"Like just look in front of you here. Climate change is right in front of us. Like right now we're dealing with how to protect our graveyard from erosion. It's happening. The water is 20 feet away from our graveyard and that's meaningful right in our face… I'm not trying to be dramatic*".

8.3 Parallels with Interpretative Repertoires Described in Earlier Geoengineering Social Science Literatures

Despite the diverse and idiosyncratic ways in which they are articulated, the fact that recognizable routines of metaphors, frames, storylines and policy positions etc. can be traced from diverse entry points into thinking about geoengineering is an interesting finding in itself. Some of these parallels with earlier literatures will therefore be briefly summarized, to illustrate that through this study, familiar expressions of meaning-making have been traced from academic and policy realms, into this less (overtly) technical domain. These parallels will also suggest that some of the discursive practices, arguments, evaluations and prescriptions analyzed in this case study of perceptions of an ocean fertilization project, have some recognisable salience with literatures developed in the context of a wider range of geoengineering technologies including solar radiation management proposals[145]. Further they will demonstrate that interpretive resources described through more abstract entry points into thinking about the idea of geoengineering, such as in studies of media and policy discourse and analyses of deliberative consultations and focus groups, have also been performed in this place-based experience of 'geoengineering'.

Some such recognisable routines of meaning-making can be traced through the accounts of the 'geoengineering' ambitions of the HSRC described in the '**Mastering Nature and the HSRC**' frame, that draws on ideas such as 'playing God' and the possibility of karmic retribution or divine punishment for human 'hubris'. This frame reflects for example, Buck's (2013a) 'Cautionary' frame, which questions the existential *right* of humans to attempt to modify the ocean and climate systems. It also reflects the idea that 'Nature Bites Back" in Corner et al. (2013: 943), as well as Scholte et al.'s (2013) 'Norms and Values' frame and Porter & Hulme's (2013) 'Morality' frame.

The techno-optimism of the '**Developing Nature and the HSRC**' frame suggested that ocean fertilization may be practical and controllable and assumes that risk can be calculated, assessed in objective terms and managed. This invokes similar ontological and epistemological assumptions about human problem-solving abilities to those implicit in Galaragga & Szerzynski's (2012: 228) "Climate Architect" figure. It also echoes the "We are the Planetary Maintenance Engineers" viewpoint constructed in Cairns & Stirling's (2014: 31) Q-sort analysis and it resonates with a more techno-mechanistic view of natural systems, as described by Nerlich & Jaspal's (2012: 131) geoengineering metaphor of the Earth as a 'machine'. Related assertions about the leverage that science and technology offers humans, and their resulting ability to affect or control the global climate system meanwhile also echoes the 'Innovation' frame in Porter & Hulme (2013). In a similar vein, Clingerman's (2014: 11) suggestion that, for some, the human role in nature is to

[145] Whilst for ease of expression, the particular technological focus of different literatures is not specified in the text that follows, the literatures referenced consider a wide range of technologies operating under the meta-label of 'geoengineering'.

"humanize" natural systems to make them work harder and better, also resonated with the 'Developing Nature and the HSRC' frame. Such ideas of enhancing function and maximising efficiency that were described through this frame also followed Scholte et al.'s (2013) 'Benefits for Society' frame. This advocates exploring the potential for society to benefit from geoengineering through avoiding climate change and opening up new (e.g. economic) opportunities.

Debates about the likelihood and the nature of harm that could be caused by geoengineering, relative to the risks of unmitigated anthropogenic climate change, described in the '**Conserving Nature and the HSRC'** frame, similarly reiterate 'Risk' framings interpreted in Porter & Hulme (2013). Familiar concerns about the potential for the HSRC's ocean fertilization experiment to result in runaway impacts, unintended consequences, socio-technical lock-in and the possibility that through ocean fertilization humans are just storing up problems for the future, were all raised through this frame (c.f. Carr et al., 2012; Clingerman, 2014; Corner et al., 2013; Lovelock, 2008; Macnaghten & Szersznyski, 2013; Porter & Hulme, 2013). However, reflecting Sikka's (2012) discourse of 'Philosophical Exceptionalism', and the 'Pragmatism' frame in Scholte et al., (2013), in the 'Conserving Nature and the HSRC' frame these concerns were tempered by 'climate emergency' (c.f. Buck, 2013a; Corner et al., 2013; Nerlich & Jaspal, 2012; Porter & Hulme, 2013) and 'tipping point' (c.f. Bellamy & Hulme, 2011) metaphors. Akin to the discourse of "The Scientist's Double Fear" detailed by Anselm & Hansson (2013: 107), the 'Conserving Nature and the HSRC' frame therefore suggested that geoengineering may be our only hope for "Avoiding Catastrophe" (c.f. Scholte et al., 2013: 6) and a necessary "Plan B" (c.f. Nerlich & Jaspal, 2012: 104). As seen in earlier literatures, these metaphors were supported by political realism (c.f. Buck, 2013a; Corner et al., 2011) and, echoing "The Failure of Politics and Cynical Industrial Fatalism" frame in Anselm & Hansson (2014: 110), were described as the price of political failure.

The 'Conserving Nature and the HSRC' frame also brought to the fore a range of storylines and metaphors associated with Buck's (2013a) framing of geoengineering as a "Spacio-temporal Struggle". While, reflecting 'Governance', 'Security' and 'Justice' frames in Porter & Hulme, (2013), this frame also emphasized familiar geopolitical concerns about hegemony, global justice, public participation and democracy in decision-making and debates about the role for regulation and of commercial entities (c.f. Macnaghten & Szerszynski, 2013).

The '**Preserving Nature and the HSRC**' frame emphasized a 'Naturalness' heuristic that echoed literatures that suggest geoengineering risks corrupting 'natural orders and boundaries' (c.f. Carr et al., 2012; Clingerman, 2014; Corner et al., 2013; Sandler, 2012a) and risks the 'death' of 'wild', 'unmodified' nature (c.f. McKibben, 2003[1989]). Reflecting a finding in Corner et al., (2013: 943) this frame suggested that geoengineering represents humanity living "out of sync" with nature. The

'Preserving Nature and the HSRC' frame also reflected earlier ethical anxieties about the 'moral hazard' of geoengineering (e.g. Hamilton, 2011b) and the "Geoengineering is a Political Strategy" frame, described in Cairns & Stirling (2014: 31). It suggests that ocean fertilization merely supports the status quo of materialism and greed, at the expense of environmental protection (c.f. Corner et al., 2013). In this way the 'Preserving Nature and the HSRC' frame also reflected the 'Economics' frame in Porter & Hulme (2013) which considered the ways in which geoengineering may maintain or strengthen existing economic structures, and the desirability of this.

The '**Restoring Nature and the HSRC**' frame reiterated the 'Bildungsroman' frame depicted in Buck (2013a), which drew on such metaphors as "The Planet is a Patient" and "The Planet is a Body" (Nerlich & Jaspal, 2012: 138) to debate the possibility that ocean fertilization could offer what Nerlich and Jaspal describe as a "Medical Fix" to climate change. The '**Working with Nature and the HSRC**' frame reflects the storyline of "Just Mimicking Nature" described in Anselm & Hansson (2014: 113) which, through the idea that ocean fertilization has natural analogues, suggests that ocean fertilization has "obtained it's proof of concept from Nature" (p.114). This is reminiscent of the 'Regenesis of Nature' storyline in Corner et al. (2013: 944) that garners support for solar radiation management proposals by suggesting that "it at least operates within pre-existing natural systems". The '**Living with Nature and the HSRC**' frame meanwhile reflects literatures that suggest climate to be outside of the realms of human influence (e.g. Donner, 2011, 2007; Mortreux & Barnett, 2009; Gifford, 2011) and has resonance with arguments of climate skepticism. This position was somewhat echoed for example in Macnaghten & Szerszynski (2013), where participants challenged the idea that climate science could act as a "reliable guide to policy" and suggested that "nature may operate according to processes and cycles that are barely comprehended by contemporary science".

8.4 Can 'Geoengineering' in Haida Gwaii Tell Us Anything About the Way in Which 'Geoengineering' is Constructed Elsewhere?

The goal of this research was to develop detailed interpretations about a specific case of 'geoengineering', rather than to attempt to generalize theoretical propositions to wider populations. Nevertheless as I have argued above, discourses, frames, metaphors and policy positions familiar to wider geoengineering literatures can been traced in this case study. This finding begins to suggest firstly, that earlier deliberative methods, which have echoed many of these same interpretative resources, have ostensibly done well to create meaningful dialogues and public consultation exercises that have overcome some of the methodological complications and potential pitfalls and challenges that arise from exploring 'geoengineering' "upstream", where awareness of geoengineering is typically low (e.g. Bellamy et al., 2014; Corner et al., 2013; Macnaghten & Szerszynski, 2013). Given their salience across multiple domains, this finding also suggests that many of the discourses, frames, metaphors, policy prescriptions etc., documented in earlier

geoengineering social science literatures and re-interpreted in this case study, are likely to continue to find resonance across a range of entry points into thinking about geoengineering.

In this case study the precise expression of these interpretative resources remained contextually unique, reflecting the distinctive cultural, political and geographical context in which the HSRC project unfolded. Nevertheless this familiarity of some of the interpretative resources identified within the case study discourse, also forms the first piece of evidence that suggests that 'geoengineering' "at the Edge of the World", as author Susan Musgrave (2015, *in press*) aptly labels Haida Gwaii, might actually have some value for helping to make sense of some of the ways in which 'geoengineering' debates are constructed elsewhere. This point can be elaborated, and argued more convincingly through the actual frames and factors constructed in this thesis and through reflection on the extent to which these draw on wider cultural meanings and relate to wider literatures that consider the human relationship with nature.

8.4.1 A Generic Frame Schedule

Through the 'informed grounded theory' approach to interrogating the case study data (section 4.2.4.1), in this thesis I have regularly been able to link analysis of implicit ontological, epistemological and axiological assumptions about the role and nature of 'nature' and human agency in the case study discourse, to wider literatures that consider the human relationship with nature. These references to salient literatures have been interspersed throughout the analysis. However the labeling of the frame schedule is another particularly visible way in which analysis of the data links with these wider literatures.

With the aim of developing the most pertinent and meaningful set of frames to describe and categorize my interpretation of the case study discourse, in phase one of this research I sought to develop an 'issue-specific' frame schedule. Yet, rather being 'issue-specific' as I envisaged, in fact the frames developed in this research engage with ideas and terms familiar to a range of environmental debates (c.f. Porter & Hulme, 2013). Indeed ideas of 'Mastering Nature', 'Developing Nature', 'Conserving Nature', 'Restoring Nature', 'Preserving Nature', 'Working with Nature' and 'Living with Nature', and their subsequent factor interpretations, start to reflect contested philosophical ground of wider environmental management and restoration discourses (e.g. Smith, 2013) and connect with cultural meanings expressed and debated in other domains. The framing schedule therefore accords more closely with the notion of 'generic' frames that transcend thematic limitations and could apply to a range of other issues (de Vreese, 2005, 2002).

The likeness of the research frames to more generic styles of frame analysis, and the finding that they construct ideas familiar to, and enduring across, other technological and environmental

debates, emphasizes that ideas of 'geoengineering' are situated within the legacy of an expansive history. It also underlines that accounts of 'geoengineering' serve as vectors for more general social and cultural anxieties, as well as issue-specific concerns and problem definitions.

'Generic' frames are theoretically better suited to generalization, comparison and use as empirical evidence for theory building (de Vreese & Lecheler, 2012). This finding therefore also begins to suggest that the frame schedule might potentially serve as a useful resource to help structure a meaningful interpretation of diverse ontological, epistemological and axiological assumptions about the role and nature of 'Nature' and human agency in wider debates about the desirability and feasibility of 'geoengineering'. Developed through a particular situated engagement with 'geoengineering', these frames cannot be automatically assumed to have any such transferability to other settings and they certainly are not intended to be understood as exhaustive. However further research to assess the salience of these frames in a range of other social and geographical contexts and possibly even in discourse pertaining to other forms of 'geoengineering' technology could prove rewarding.

8.4.2 Ecological Worldviews and the Three Q-Study Factors

Returning to the conceptual ground of the 'worldviews' literature (reviewed in chapter 3) allows me to further elaborate on this interpretation of the potential relevance of the findings of this study for wider geoengineering debates. Although to be clear I embark on such an elaboration tentatively.

This thesis employed the notion of 'ecological worldviews' as a conceptual lens through which to structure an empirical investigation of the way in which people construct diverse beliefs, values and assumptions about the role and nature of 'Nature' and human agency through debate about the desirability and feasibility of the geoengineering ambitions of the HSRC. Hedlund-de Witt's (e.g. 2012) Integrative Worldviews Framework was then employed in this thesis as a methodological tool, to render the amorphous idea of 'worldviews' more readily researchable. The IWF was compatible with the constructivist research paradigm of the thesis that understood worldviews "are not in the person but in the performance" (c.f. Mcnamee, 2004: 39). And the framework was felt to be suited to facilitating a systematic, comprehensive and responsive interpretation of the diverse assumptions, ways of knowing and values that could be interpreted from the performance of 'geoengineering' discourse (see section 3.4.3).

I believe that the IWF has proved its worth in this regard. By encouraging the systematic scrutiny of the case study discourse through each of the five IWF dimensions of 'ontology', 'epistemology', 'axiology', 'anthropology' and 'societal vision' (see figure 3.2), I have been able to offer transparency and structure to the development of my case study frames and to the development of the Q-

statements used in the Q-study. I have also been able to ensure that my analysis was open to reflection on a range of the dimensions of 'environmental attitudes' facilitated by existing 'measures' of such attitudes, whilst ensuring that other previously underemphasized aspects of 'environmental attitudes' research – such as epistemological or spiritual commitments – did not go neglected (Hedlund-de Witt et al., 2015).

As detailed in section 3.4.3.1 however, Hedlund-de Witt (e.g. Hedlund-de Witt & Hedlund-de Witt, 2015, *in press*) also extended the use of the IWF framework by using it to develop a set of 'ideal-typical' worldview heuristics, that were intended to capture the 'families of views' (c.f. Taylor, 1989) predominant in the contemporary Western cultural landscape. Through her own qualitative and quantitative research and extensive literature review (e.g. Hedlund-de Witt, 2013a; Hedlund-de Witt et al., 2015, Hedlund-de Witt & Hedlund-de Witt, 2015, *in press*), Hedlund-de Witt posits the existence of at least three major worldview structures in the West which, reflecting conventions of earlier research (e.g. Inglehart, 1997; O'Brien, 2009; Taylor, 1989), she labels 'traditional', 'modern' and 'post-modern' worldviews (Hedlund-de Witt & Hedlund-de Witt, 2015, *in press*: 18,). As well as having a widespread "cultural caché" that allows them to be grasped relatively intuitively, these labels reflect she says, the "historical-developmental trajectory of cultural epochs and worldviews in the West, described by philosophers of Western thought, historians, and social scientists" (Hedlund-de Witt et al., 2015: 4, see also section 2.8.3).

Hedlund-de Witt (& Hedlund-de Witt, 2015, *in press*) tentatively depicts 'logically constructed' models of these 'ideal-typical' worldviews using the five major aspects of worldviews denoted by the IWF as an organising scheme. This heuristic delineates a provisional interpretation of the primary assumptions, themes and concerns of each of the ideal-typical worldviews. It has been recreated for reference in Appendix 3.2. She does not however suggest that these ideal-typical heuristics have any uncomplicated correspondence with lived experience. Instead these heuristics are designed to offer only "sweeping generalisations of the complexities and ambiguities of reality" (Hedlund-de Witt, 2014: 8316) and should be understood as neither exhaustive nor definitive. Human beings "cannot be exhaustively described through any theoretical framework" she attests (Hedlund-de Witt & Hedlund-de Witt, 2015, *in press*: 23). Thus her worldview heuristics are intended to refer only to general homologies of observed similarities in perspectives, in order to help conceptualise the "seeming chaos of social reality" (Hedlund-de Witt et al., 2015, *in press*: 4). Hedlund-de Witt has then applied these heuristics with some convincing results to suggest that these ideal-typical worldviews correlate with pro-environmental attitudes and sustainable lifestyle choices (Hedlund-de Witt, 2013a). She also suggests that they inform different visions of 'development' and 'quality of life' (Hedlund-de Witt, 2014) and that they underlie the dominant social responses to industrial biotechnology (Hedlund-de Witt, et al., 2015).

I am naturally skeptical of the value of any framework that attempts to constrain socio-cultural relativism to such an extent as to classify the fluid and dynamic nature of beliefs and values to such a small number of 'ideal-typical' expressions. Therefore not wanting to confine analysis to existing classification systems (see section 3.4.2.1), I did not set out to uncover or test the phenomenological value of these heuristics in my research setting. In the course of my analysis however, some notable interpretative overlap has emerged between my interpretation of the configuration of ontological, epistemological and axiological, assumptions expressed in my Q-study factors (summarized in figure 8.1) and the ontology, epistemology, axiology, anthropology and societal vision delineated in Hedlund-de Witt's ideal-typical 'traditional', 'modern' and 'post-modern' worldview heuristics (summarized in appendix 3.2).

The configuration of ontological, epistemological and axiological assumptions in Factor 1a '**Ocean fertilization is morally wrong. We need to preserve the natural order**' shares some broad consistencies with Hedlund-de Witt's 'Traditional' worldview heuristic. Factor 1b '**Ocean fertilization should be urgently explored. Through science we can respond to the challenges of climate change**', shares some general similarities with Hedlund-de Witt's 'Modern' worldview heuristic. While Factor 2, '**Climate and ocean systems are dynamic and interconnected. Ocean fertilization is very risky**', in some ways echoes the configuration of assumptions described through Hedlund-de Witt's 'Post-Modern' worldview heuristic.

These parallels are not neat, complete or consistent. However Figure 8.2 below attempts to highlight some of the ontological, epistemological and axiological assumptions that find *some* interpretative salience across Hedlund-de Witt's's ideal-typical worldviews *and* my Q-study factors, themselves constructed to express participants' views vis-à-vis ocean fertilization. Similar interpretative parallels could be drawn with the wide body of 'worldviews' literature that Hedlund-de Witt reviewed in the development of these worldview heuristics (e.g. Inglehart, 1997; Inglehart & Welzel, 2005; O'Brien, 2009; Taylor, 1989). However since Hedlund-de Witt's worldview heuristics represent the most comprehensive synthesis of these literatures, these literatures are not reviewed individually.

Figure 8.2: Interpretative parallels between IWF ideal-typical 'traditional', 'modern' and 'postmodern' worldviews and the configuration of ontological, epistemological and axiological assumptions interpreted from the Q-Methodology factors

	Hedlund-de Witt's 'Traditional' worldview Factor 1a: 'Ocean fertilization is morally wrong. We need to preserve the natural order'.	Hedlund-de Witt's 'Modern' Worldview Factor 1b: Ocean fertilization should be urgently explored. Through science we can respond to the challenges of climate change	Hedlund-de Witt's Post-Modern Worldview Factor 2: Climate and ocean systems are dynamic and interconnected. Ocean fertilization is very risky
Ontology	Nature as embodiment of meaningful, imposed order (e.g. God's creation/Mother Nature).	Nature as instrumental resource for humanity to use. Secular cosmology.	Nature as complex and interconnected. Earth has natural limits. Secular cosmology.
Epistemology	Different forms of moral and religious knowledge are afforded particular value.	Trust in science, technology and instrumental reasoning. (Post)positivism.	Philosophical pragmatism. Systems-view.
Axiology	Humility. Respect for tradition, and sacrifice. Emphasis on community.	Materialist-value orientation. Protection of individual freedoms.	Post-materialist values. Global justice dimensions emphasized.
Anthropology	Humans subject to meaningful natural order.	Self-optimizing human being develops nature to advance human wellbeing.	Humans in cautious relationship to nature.
Societal Vision	Technological intervention in nature a priori unacceptable.	Technological optimism.	Techno-cautious.

(Based on Table 1 in Hedlund-de Witt et al., 2015 (see appendix 3.2), and figure 8.1 above.

8.4.3 The Case Study Factors as Provisional Orienting Heuristics

The findings of this research help support the suggestion that the 'worldview' construct, (as articulated through Hedlund-de Witt's IWF), may serve as a useful conceptual tool for thinking about social meaning-making. Hedlund-de Witt (2012: 75) characterizes 'worldviews' as "not a patchwork of loosely related phenomena but a coherent pattern or *system* that integrates seemingly isolated ideas into a common holistic structure". In this thesis Q-Methodology explored how seemingly isolated ideas may be integrated (through the expression of factors) from the way in which participants organised their Q-statements. The resulting Q-study factors in this research pay homage to this holistic characterization of worldviews by exhibiting a degree of interpretative coherency. Broadly speaking, interpretations about the kind of knowledge that can be attained and considered valid for example, allegorically map onto interpretations about the role of science and

technology. Different interpretations about the nature of 'nature' meanwhile ostensibly map onto interpretations about the role of human agency.

The worldview concept also offers an interpretation of how 'geoengineering' discourse in this research has been able to manifest as idiosyncratic and contextually unique, yet still demonstrate some shared interpretative features and ontological, epistemological and axiological assumptions expressed across social and spatial scales. 'Worldviews' Hedlund-de Witt (2013a: 266-267) writes "should be understood as *deep* structures or underlying dynamical patterns that vary in terms of their culturally and individually relative *surface* contents or expressions (see e.g. Wilber, 2000, drawing on Noam Chomsky). For example, a traditional ontology will be expressed through different surface contents depending on whether that worldview is situated within a Christian or Hindu religious-cultural context, but [it] will share certain underlying commonalities" (see section 3.3).

The finding that the factors constructed in this research reflect facets of Hedlund-de Witt's ideal-typical worldview heuristics may also serve as further evidence of the value of these heuristics for illuminating the deeper values, assumptions and 'ways of knowing' that shape complex sustainability debates. To be clear, however, my emphasis on the similarities between the findings of this study's Q-sort analysis and the character and depiction Hedlund-de Witt's ideal-typical worldview heuristics is not intended to suggest that my research has, in some way, described 'worldviews' that exist 'out there'. And the value of these parallels must not be overstated.

Hedlund-de Witt is clear that people cannot be understood to conform to her worldview heuristics in any kind of rigid way and this point is illustrated particularly clearly in my study through the finding that no participants loaded perfectly onto any Q-factor. Further, just as Hedlund-de Witt suggests that ideal-typical worldviews will likely be combined and reformulated by individuals, the Q-sorts of some participants in this study loaded significantly onto more than one study factor. This suggests that individuals within the case study blended the perspectives constructed and reinterpreted through the factors. Every individual in Haida Gwaii offered a unique account of the desirability and the feasibility of the geoengineering ambitions of ocean fertilization and the ways in which these accounts were articulated varied enormously. The Q-study factors therefore risk curating analysis too finely, reducing the complexities of reality and truncating the subtleness of interpretations at the expense of less dominant perspectives. Consequently these study factors hold the potential to further marginalize alternative voices and ways of knowing ocean fertilization.

Despite these limitations, interpretative overlap with earlier literatures that have sought to 'measure' or characterize dominant Western cultural currents in human meaning-making does suggest that

the Q-study factor interpretations, and their particular configurations of diverse ontological, epistemological and axiological assumptions about the nature of 'nature' and human agency, may well find some resonance with 'geoengineering' meaning-making outside of the immediate case study context. Further research would be needed to test the validity of this claim for other geoengineering technologies, and especially outside of Western contexts[146]. And the factors must be treated as provisional orienting heuristics, rather than as some kind of comprehensive explanatory theory for different interpretations about the desirability and feasibility of geoengineering (c.f. Mamadouh, 1999).

Nevertheless, provided that the limitations of these factors are acknowledged, I propose that the Q-study factors could potentially serve as useful mnemonics for helping to conceptualise general homologies of perspective, and some of the deeper contested values, assumptions and epistemologies about the role and nature of 'nature' and human agency, that drive public contestation about geoengineering in the contemporary West (c.f. Hedlund-de Witt, 2013a). As this thesis draws to a close, I will offer some brief reflection on the potential value of such heuristics for facilitating greater reflexivity in geoengineering decision-making.

8.5 A Reflexive Lens for Geoengineering Decision-Making

The factors and frames described in this thesis have illustrated the constructed nature of geoengineering. 'Geoengineering' is not only itself an unstable and contested concept (Macnaghten & Szerszynski, 2013). But this analysis has shown that debates about the desirability and feasibility of exploring the potential of geoengineering technologies as a partial solution to anthropogenic climate change, take shape around fundamentally different values, meanings, attitudes and expectations about the nature and condition of natural systems, about the types of knowledge that can be considered valid and about the role of human beings.

To echo the words of Hedlund-de Witt (2013a: 275), in the geoengineering debate therefore "clearly much more is at stake than an argument over scientific facts". Humanity is not "one big happy, global and intergenerational family" with shared values and beliefs (Gardiner, 2011b in Buck, 2012b: 136). Indeed the emergence of a bipolar factor in the Q-study in this thesis begins to hint at how deeply entrenched some of the competing values and perspectives may be. Instead geoengineering is imbued with debate about values and meanings, about rights and responsibilities, about instincts and aspirations and about how the world is and how it should be.

[146] This research has gone some way towards expanding an interpretation of the possible salience of HDW's ideal-typical worldview heuristics to incorporate a particular group of Indigenous perspectives, but these remain situated within a typically Western cultural context.

Explicitly reflecting on the constructed nature of geoengineering discourse is especially important as geoengineering frames, documented in this study and elsewhere (e.g. Sikka, 2012), have often been argued to be powerfully internally validating. By structuring their own rhetorical 'closing down' of the debate, these frames may leave these contested values and assumptions closed to being challenged.

By heuristically drawing out a number of these key contested assumptions, values and visions at play in geoengineering discourse, provided that the limitations of the frames and factors developed in this study remain clear, I have proposed that both may potentially serve as useful provisional orienting heuristics for opening up reflexivity in geoengineering debates, as chapter 2 argued is desperately needed. They could, for example, help encourage critical self-reflection among policy makers on the values, assumptions and biases being mobilized through the development and selection of geoengineering policy prescriptions (c.f. Hedlund-de Witt, 2013a). The frames and factors need not be 'comprehensive' or universally salient to be able to perform some form of heuristic role in this regard. Reflexivity around the core assumptions and motivations shaping different geoengineering problem diagnoses could help decision-makers reconstruct their approach to geoengineering with a clearer focus.

Hedlund-de Witt (2013a) also suggests such self-awareness is important for developing mutual understanding and empathy with those who espouse alternative perspectives. In the same vein, the study frames and factors could help encourage greater understanding about some of the values and motivations that shape alternative perspectives in respect to geoengineering. This research suggests that geoengineering technologies are always going to be contested because they interact with these multiple and diverse ways in which people understand human nature in relation to the non-human world. However as Thompson & Rayner (1998: 335-336) explain, "recognising epistemological and ethical diversity does not lead inexorably to… political paralysis. Rather, it provides a realistic perspective from which to participate in debate with a heightened ability to listen to and understand the arguments and stand points of other[s]".

Should the study frames and factors be able to serve some purpose as a scaffold for communication, they may be able to help prevent stakeholders from talking past each other and encourage dialogue rather than monologue and interchange as well as exchange (Howitt, 2001). The different factor heuristics bring forth different opportunities and different strengths and weaknesses (c.f. Hedlund-de Witt, 2013a). Thus greater mutual understanding and dialogue in turn may present opportunities for identifying shared goals and for developing innovative solutions.

In this research I have demonstrated that people think about geoengineering in different ways based on different normative assumptions and ontological strategies. By breaking down notions of "truth" and demonstrating that any claim to a "right", "just", "rational" or even "scientific" position on geoengineering will be ontologically, epistemologically and axiologically situated, I believe that the most important contribution that this reflexivity could offer therefore is through its implicit call to the democratic process. Formalised frameworks for assessing geoengineering have typically only considered limited technocratic, risk-based metrics (Bellamy et al., 2012). However if decision-making on geoengineering, at any spatial scale, is to avoid becoming anything other than a simple expression of hegemony, there is a need for reflexive governance that is clear about whose visions are being pursued and whose values are being ignored. By insisting that 'geoengineering' must not pass under the radar of ontological, epistemological and axiological reflexivity, I hope that this thesis can go some way towards breaking down the rhetorical 'hall of mirrors' (section 2.4.1.1) and resisting any attempt to 'deep colonize' (Rose, 1996: 6) this issue of great global consequence.

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Appendix

Appendix 2.1: Selected geoengineering frames, storylines and themes documented in previous social science geoengineering literatures

Paper	Data analyzed	Discursive Frames/Storylines/ Narratives	Key Features of Frames/Storylines
Anshelm & Hansson (2014)	Discourse of newspaper articles on geoengineering written in English, German, Swedish, Danish & Norweigian and published between 2005-2013	"The scientists' double fear"	Geoengineering researchers, who would have previously considered geoengineering to be 'taboo' or 'foolish', have in this storyline come to reassess their position in the face of the severe risks of climate change. Catastrophic climate change is upon us and thus geoengineering, while 'extreme' or even 'dangerous', may be warranted for the 'survival of civilisation. (c.f. 'avoiding catastrophe' frames in Scholte et al., (2013) and geoengineering as 'Plan B' in Nerlich & Jaspal, (2012)).
		"The failure of politics and cynical industrial fatalism'	In this storyline, given the consistent and incompatible aspiration for economic growth, political negotiations on mitigation have failed and climate change is locked in. Geoengineering is the only remaining option and it – and its potentially devastating environmental and human costs – is the price of political failure. (c.f. Governance frames in Porter & Hulme, (2013)).
		"Pure technology: a bridge to a sustainable future"	Exercised through metaphors such as geoengineering as a 'Plan B', in this storyline geoengineering may offer a 'technological fix' (c.f. Nerlich & Jaspal, 2012) to climate change, or at least 'buy us time' and offer a 'bridge' to a reformed and sustainable energy future. Geoengineering is a pure technological challenge and risks can be managed and observed through the slow and cautious deployment of technologies and careful monitoring (c.f. Innovation frames in Porter & Hulme (2013)).
		"Just mimicking Nature"	In this storyline, geoengineering scientists have 'obtained their proof of concept from Nature' (Anselm & Hansson, 2014: 114) and through geoengineering have set themselves the task of harnessing, and even developing, natural processes, through which Nature cleans herself. Geoengineering is not strange or unnatural, nor is it particularly risky. 'How could it be hazardous is nature had used the same processes before humans existed?' (*ibid*). Geoengineering here is almost inevitable since Nature has shown the way and humans must now follow.

Buck (2013a)	A sample of print and online news media articles published between 1990 and mid-2010	'Catastrophic' 'Managerial' 'Cautionary' 'Spatiotemporal struggle' 'Bildungsroman'	Catastrophic framings are indicated through the discursive elements of 'crisis' and 'inevitability'. The planet is in urgent trouble and is in need of saving, thus geoengineering may now be necessary (c.f. 'avoiding catastrophe' frames in Scholte et al., (2013)). Managerial framings may be indicated through visions of the future, constructed to portray a successfully managed and ecologically modernised earth. Debates about the risks and rewards of geoengineering the climate, cost estimates and discursive material attempting to educate readers on science were similarly suggested to be formative in managerial frames. Accounts which question the right or existential ability of humans engineering the climate (c.f. 'Norms and Values' frames in Scholte et al., (2013) & 'Morality' frames in Porter & Hulme, (2013)) reflect a cautionary frame. As do frame elements that describe geoengineering as 'science fiction', 'fantastic' or 'futuristic'. Framing geoengineering as a 'spacio-temporal struggle' is achieved through reflection on justice debates, which highlight spatial and intergenerational challenges of geoengineering, and geopolitics concerns that cast geoengineering as an exercise in hegemony (c.f 'Governance' and 'Security' frames in Porter & Hulme, (2013)). Bildungsroman frames might position the Earth as a patient, and humans as the 'doctors and nurses', who may have the power to heal it.
Cairns & Stirling (2014)	Q-methodology discourse analysis with 35 actors from academia, industry, government, civil society and the media found to be prominent in geoengineering discourse.	"At the very least we need more research" "We are the planetary maintenance engineers" "Geoengineering is a political strategy"	The frame constructed through this factor distinguishes geoengineering deployment from research, describing the failure to at least research geoengineering options as dangerous. Not least research should establish which approaches to avoid if we become desperate enough to resort to geoengineering. This factor frames geoengineering as inevitable. The climate system is in an unprecedented and dire state of emergency (c.f. Buck, 2013a). If catastrophe is to be prevented, human problem solving abilities must be harnessed to develop geoengineering options. This must start now, before it is too late. This frame offers an account that describes geoengineering as building on the dangerous illusion that complex social problems can be solved by technology, when in fact the consequences of geoengineering are unpredictable and may cause irreversible harm. The technologies needed for global emissions reductions exist today, making geoengineering a political strategy that supports the status quo. Climate policy should not be a product of hegemony but should emerge from

		"Let's focus on carbon"	meaningful public engagement. This frame attests that the climate system is too complex and chaotic to be able to judge cause and effect of various geoengineering ideas. But since *some* new technologies will be needed to address climate change, we should focus efforts on the problem requiring action: the accumulating carbon dioxide in the atmosphere.
Nerlich & Jaspal (2012)	English news articles from the 'Industry Trade Press' on the LexisNexis database published prior to January 2011.	Geoengineering as a 'techno-fix'	Articulated especially through the conceptual metaphors of 'the planet is a machine', the theme of geoengineering as a 'techno-fix' is linked for example to the idea that geoengineering could offer the necessary technological 'toolkit' that could – or indeed could not - fix the 'broken' climate.
		Geoengineering as a 'medical fix'	Gaining particular salience through the conceptual metaphors of the 'planet is a body' and the 'planet is a patient', through the idea that geoengineering is a 'medical fix', climate change is described for example through the lens of addiction, withdrawal and medical treatment. The planet needs to be 'saved' from the 'illness' of over-consumption or even 'addiction' to carbon.
		Geoengineering as 'Plan B'	An idea generally used to argue that 'something needs to be done', through the related metaphor of geoengineering as 'an insurance policy', geoengineering as 'plan B' often finds its salience through an argument of catastrophe. Geoengineering may become, in effect, the only backup plan we have to save the planet (c.f. 'Catastrophic' frames in Buck, (2013a)).
Porter & Hulme (2013)	Newspaper articles from the UK national press, focused on geoengineering published before 17th April 2011.	Innovation	Innovation framings debate the leverage that science and technology offers humans and their resulting ability to affect or control the global climate system. Such debates focus on discussion of feasibility – whether or not humanity has the knowledge and technical prowess to mediate the climate through geoengineering.
		Risk	Risk framings encompass debates about the likelihood and the nature of harm that could be caused by geoengineering with accounts of the 'riskiness' of geoengineering ranging from 'benign' and 'safe' to potentially 'catastrophic'. Accounts often consider the dangers of engaging geoengineering relative to the risks of unmitigated anthropogenic climate change and diversely represent (un)certainty and (ir)reversibility associated with geoengineering.
		Governance and Accountability	Governance and accountability frames tend to focus on accounts of the institutions and political mechanisms through which geoengineering would and should be governed. Debates about democracy and power structures interact with such

			framings as the roles of states, international governance institutions and industry go disputed, especially around the issue of who should get to deploy geoengineering. Debate about public participation, regulatory process, political feasibility and international law are also signifiers of this frame.
		Economics	How much technologies cost, who is going to pay for them, their cost efficiency and the way in which they may support national and international economies and industries are all found to be debated through economics frames. The ways in which using geoengineering may maintain or strengthen existing economic structures, and the desirability of this, is also contested.
		Morality	Morality frames make explicit normative judgements about the relative 'rightness' or 'wrongness' of deploying and researching geoengineering technologies. Hubris and ideas of 'playing God' interact with ideas about responsibility and redemption in questions that reveal contested assumptions about the role of human agency in the natural world (c.f. Cautionary' frames in Buck (2013a) and 'Norms & Values' frames in Scholte et al., (2013).
		Justice	Justice frames are similarly overtly normative and are signified by discussion of such issues as what is to be lost or gained from geoengineering, and who will be the winners and the losers. International development goals interact in such framings, for example, and geoengineering is conceived of as both a means through which to advance development efforts and as a threat to its sustainability.
		Security	Security frames visibly draw out specific dimensions of both 'Risk' and 'Governance & Accountability' frames. Understanding geoengineering as either a threat or a solution to local, national or international security concerns, such frames may similarly debate the role of potential geoengineering actors as a cause of, or threat to, security.
Scholte et al., (2013)	English-language newspaper articles focused on geoengineering published between 2006-2011	'Ambivalence'	A frame weighing risks and benefits (c.f. risk frames in Porter & Hulme, (2013)).
		'Avoiding catastrophe'	A frame that describes the planet as in trouble from climate change and in need of saving (c.f. catastrophic frames in Buck, (2013a)). In this plight, geoengineering may be our only hope (c.f. "The scientists' double fear in Anshelm & Hansson, (2014) and geoengineering as 'Plan B' in Nerlich & Jaspal, (2014)).
		'Pragmatism'	A frame that describes geoengineering as previously belonging to the fringes of science but that now warrants serious consideration in the face of current failures.
		'Norms and 'Values'	A frame that explores the acceptability of geoengineering relative to the relationship

			between man and nature (c.f. 'Cautionary' frames in Buck, (2013a) and 'Morality' framings in Porter & Hulme, (2013)).
		'Benefits for Society'	A frame exploring the potential for society to benefit from geoengineering, through avoiding climate change and opening up new (e.g. economic) opportunities.
		'Controversy'	A frame that focuses on the contentions of geoengineering engaging directly with competing interests and claims.
		'Techno-fix'	A frame that describes geoengineering as a techno-fix for climate change where the problem can be dealt with through technology (c.f. Geoengineering as a 'techno-fix' in Nerlich & Jaspal, (2012) and Innovation frames in Porter & Hulme, (2013)).

Appendix 3.1: An Overview of The Douglas & Wildavsky's (1983) Grid-Group Cultural Orientations and the Four Different Implicit Views of Nature Identified by Thompson et al (1990).

Fatalists – Nature 'Capricious'	Douglas suggests that fatalists are high 'grid' and so see their autonomy as restricted by institutional and social classifications such as age and gender. But being low 'group', fatalists position themselves as isolated individuals within these systems. According to cultural theory, fatalists are predisposed to feel powerless in the face of change and perceive the outcome of events as subject to such notions as 'fate' and 'chance' In Thompsons' elaboration, nature is 'capricious', random and fundamentally unpredictable, thus humans just have to 'cope' with the erratic events that may arise.
Hierarchists – Nature 'Perverse/Tolerant'	Also high 'grid', like fatalists, hierarchists see their autonomy as being defined by social distinctions, but unlike fatalists, hierarchists feel strongly 'group' oriented and see these classifications as necessary for harmonious living. Hierarchists are subject to a cultural bias that causes them to put trust in centralised institutions and governing authorities. And according to Thompson et al., hierarchists see Nature as fairly resilient, assuming it is subject to suitable management and regulation through these institutions.
Egalitarians – Nature 'Ephemeral'	Egalitarians score high on the 'group' dimension of Douglas' cultural typologies, revealing that they too experience a feeling of solidarity with their wider society. But unlike the hierarchists, egalitarians score low on the 'grid' dimension of Douglas' cultural typologies. For egalitarians humans should not be prescribed roles by social classifications and no one should be granted authority over another by virtue of these. As such egalitarians emphasize democracy and public participation in decision-making. Thompson et al. attest that for the egalitarian, nature is ephemeral, existing in a precarious state of balance. The slightest interference could trigger environmental disaster so the ecosystem needs to be treated with great caution.
Individualists – Nature 'Benign'	Individualists are not bound to group alliances or to prescribed social roles, and thus score low in both the 'grid' and 'group' dimensions of Douglas' framework. Individualists support a competitive way of life in which preserving their own autonomy is of fundamental importance. According to Thompson et al., (1990) individualists characterize nature as benign. Delightfully merciful, in this myth nature is favourably inclined towards humanity, meaning it will always return to its natural equilibrium regardless of human action. Thus providing regulation does not threaten their autonomy, individualists are characterized as having an indifferent, or laissez-faire approach to management of nature.

Appendix 3.2: Hedlund-de Witt & Hedlund-de Witt's (2015, in press) expanded Integrative Worldviews Framework (IWF) delineating ideal-typical traditional, modern, postmodern, and integrative worldviews in the contemporary West, using the five IWF worldview-aspects as an organizing scheme.

	Traditional worldview	Modern worldview	Postmodern worldview
Ontology	Religious/metaphysical monism. Reality as singular, transcendent.	Secular materialism. Reality as singular, immanent.	Post-materialism. Reality as pluralistic, perspectival, constructed.
	Universe as purposively constructed whole. God-created universe *ex nihilo*.	Mechanistic universe brought about by random mutation and natural selection.	Cosmogony as cultural construct?
	Transcendent God is separate from profane world; dualism	Material reality devoid of meaning, intentionality, consciousness; dualism, disenchantment.	Reality as discontinuous and fragmented; anti-essentialism.
	Nature as embodiment of meaningful, imposed order (e.g. God's creation).	Nature as instrumental, devoid of intrinsic meaning and purpose. Resource for exploitation	Nature as constructed through a plurality of cultural values, meanings, and interests
Epistemology	Naïve realism; emphasis on concrete-literal interpretations of religious doctrine (literalism, dogmatism).	(Post-)positivism; emphasis on reality as objectively knowable (empiricism, reductionism, scientism).	Social constructivism; emphasis on reality as constructed, perspectival (pluralism, relativism).
	Religious authority (scripture, divine revelation, tradition).	Secular authority (science, the state).	Internalization of authority (e.g. moral, emotional, intuitive, artistic knowing)
	A-methodological	Quantitative methods, methodological monism.	Qualitative methods; methodological pluralism
	Substantive rationality	Procedural rationality	Skeptical rationality?
Axiology	Traditional values (e.g. security, tradition, conformity, obedience, humility)	Rational-secular, materialist values (e.g. power, achievement, hedonism, stimulation)	Self-expression, post-materialist values (e.g. openness to change, self-direction)
	Emphasis on community, family	Emphasis on independent individuality	Emphasis on unique individuality
	Pre-conventional morality?	Conventional morality?	Postconventional morality?
Anthropology	Humanity in managerial stewardship role vis-à-vis nature	Humanity in promethean control over nature	Humanity in cautious relationship to nature
	Prime purposes determined by larger order and social roles. Human being as sinful/fallen from grace. Dependent on religious/ metaphysical authorities for salvation.	Prime purposes of a material, hedonistic nature. Human being as self-optimizing, independent being. *Homo economicus*.	Prime purposes are found within, intrinsic. Human being as self-expressing, unique individual.
	Ethno-centric identity?	Socio-centric identity?	World-centric identity?
Societal vision/ socio-technical imaginary	Traditional societies, emphasis on (subsistence) farming.	Industrial societies, emphasis on industry and commercial industrial agriculture.	Post-industrial societies, emphasis on service economy and creative industries.
	Traditional and religious authorities and values are looked at for solutions to societal and environmental problems.	Technological optimism: science and technology will solve societal and environmental problems.	Skepticism, idealism: emancipation of marginalized voices through "deconstructing" discourses and revealing power dynamics will solve societal and environmental problems

Appendix 4.1: List of Interview and Q-sort Participants

Participant Number	Pseudonym	Gender	Identifies as ethic Haida	HSRC affiliate	Community	Interview in phase 1	Completed Q-sort
1	Russell Anderson	Male			Tow Hill	Yes	Yes
2	Katherine Young	Female	Yes		Masset		Yes
3	Theresa Page	Female			Sandspit		Yes
4	Marlene Hawkins	Female	Yes		Skidegate	Yes	Yes
5	Brent Morton	Male	Yes	Yes	Old Massett	Yes	Yes
6	Ronnie Stevenson	Male	Yes		Old Massett	Yes	Yes
7	Chris Shaw	Male	Yes		Skidegate	Yes	Yes
8	Noel Townsend	Male	Yes		Old Massett	Yes	Yes
9	Ben Watson	Male	Yes		Old Massett	Yes	Yes
10	Raymond Wallace	Male		Yes	Masset	Yes	Yes
11	Harry Doyle	Male			Queen Charlotte	Yes	Yes
12	Kelly Baker	Female	Yes		Skidegate	Yes	Yes
13	Gary Bennett	Male			Masset	Yes	Yes
14	Joe Newman	Male		Yes	Vancouver/Vancouver Island	Yes	Yes
15	Jan Fields	Female			Masset	Yes	Yes
16	Lewis Fletcher	Male			Masset	Yes	Yes
17	Olivia James	Female			Masset	Yes	Yes
18	Max Cannon	Male			Masset	Yes	Yes
19	Charlotte Elliott	Female	Yes		Tow Hill	Yes	Yes
20	Ross Poole	Male			Masset		Yes
21	Susan Hughes	Female	Yes		Old Massett	Yes	Yes
22	Lloyd Jones	Male			Queen Charlotte	Yes	Yes
23	Ruth Carter	Female			Queen Charlotte	Yes	Yes
24	Rob Peters	Male		Yes	Vancouver/Vancouver Island	Yes	Yes
25	Marianne Dunn	Female			Tlell/Port Clements	Yes	Yes
26	Ryan Carr	Male		Yes	Vancouver/Vancouver Island		Yes

27	Marco Richardson	Male	Yes		Skidegate	Yes	
28	Steve Hall	Male	Yes		Old Massett	Yes	
29	Jim Ross	Male	Yes	Yes	Old Massett	Yes	
30	Dexter Simpson	Male	Yes		Skidegate	Yes	
31	Joanna Cook	Female	Yes		Queen Charlotte	Yes	
32	Ashley Turner	Male			Queen Charlotte	Yes	
33	Martin Clarke	Male			Vancouver/Vancouver Island	Yes	
34	Jack Larson	Male	Yes	Yes	Old Massett	Yes	
35	Donnie Smith	Male	Yes		Old Massett	Yes	
36	Jeff Harmon	Male	Yes	Yes	Old Massett	Yes	
37	Ricky White	Male	Yes		Old Massett	Yes	
38	Brooke Vaughan	Female			Tlell/Port Clements	Yes	
39	Tom Dawson	Male		Yes	Vancouver/Vancouver Island	Yes	
40	Tommy Day	Male			Sandspit	Yes	
41	Phillip Wheeler	Male	Yes		Masset	Yes	
42	Valerie Collins	Female			Vancouver/Vancouver Island	Yes	
43	Joseph Willis	Male	Yes		Old Massett	Yes	
44	Jane Clarke	Female	Yes		Masset	Yes	
45	Rudy Cooper	Male	Yes		Old Massett	Yes	
46	Larry Evans	Male			Tow Hill	Yes	
47	Isabel Todd	Female			Queen Charlotte	Yes	
48	Krista Tucker	Female	Yes		Old Massett	Yes	
		Male: Female 32 : 16	**24**	**9**		**44**	**26**

* For the purpose of maintaining participant anonymity residents of smaller settlements have been attributed to larger settlements. Residents of Tlaga gaw tlass are listed as Old Massett residents for example. For the same reason residents of Port Clements and Tlell are combined into one category. NB. Does not denote permanent residency.

Appendix 4.2: List of Pilot Focus Group Participants

Participant Number	Pseudoname	Gender	Identifies as Ethic Haida	HSRC Affiliate	Community *	Interview Participant	Q-sort Participant
49	Aaron Andrews	Male			Sandspit		
50	Stephanie Cole	Female			Sandspit		
51	Ashley Vaughan	Male			Sandspit		
52	Jean Lewis	Female			Sandspit		
53	Bobbie Jennings	Male			Sandspit		
54	Matt Bell	Male			Sandspit		
55	Leo Gardiner	Male			Sandspit		
56	Julian Richardson	Male			Sandspit		
57	Greg Coleman	Male			Sandspit		
58	Peter Wells	Male			Sandspit		
59	Robin Stone	Male			Sandspit		
60	Katrina Tate	Female			Sandspit		
61	Adrian McDaniel	Male			Sandspit		

Sulphate Particles

This solar climate geoengineering proposal seeks to put sulphate particles into the atmosphere in order to reflect some sunlight back into space. Scientists have discussed the possibility of doing this by pumping the particles up a tall pipe attached to a balloon; by spraying the particles from high-flying military aircraft; or by launching the particles in surface-to-air missiles. Scientists have done a number of desk-based studies, but the world's first attempt to test the equipment needed for pumping particles up a pipe attached to a balloon was cancelled because of lacking international decision making arrangements.

Photo:
https://c479107.ssl.cf2.rackcdn.com/files/4249/width496/IMG_0814.jpg

Mirrors in Space

This solar geoengineering proposal would seek to use mirrors in Earths orbit, in order to reflect some sunlight back into space. This could be done by launching trillions of small mirrors into orbit. A few desk-based studies have taken place.

Artist's impression:
http://howisearth.files.wordpress.com/2010/01/geoengineering-planet-earth-against-global-warming-mirrors-glass-discs-in-space.jpg

Cloud Brightening

This solar geoengineering proposal would seek to use technology to make clouds brighter, in order to reflect some sunlight back into space. This could be done by using automated ships to spray sea salt into the air to increase the number of cloud droplets. A few desk-based studies have taken place.

Artist's impression: John McNeill

Ocean Fertilization

This carbon geoengineering proposal seeks to dump iron nutrient into the ocean to encourage algal growth, in order to absorb more carbon dioxide and store it in the ocean. This could be done using conventional ships. A number of tests have been done in the oceans.

Photo:
http://earthobservatory.nasa.gov/IOTD/view.php?id=6296

Air Capture

Artist's impression: Carbon Engineering Ltd.

This carbon climate geoengineering proposal seeks to capture carbon dioxide from the air and store it underground (for example, in used oil and gas wells). Scientists have discussed the possibility that this could be done by building large air capture units. A number of new companies around the world are currently testing small air capture technology.

Appendix 4.4: Example Interview Crib Sheet

Did you have any involvement with the HSRC?

Can you explain to me how the HSRC project came about?

Can you explain to me your understanding of how the project was designed?

What happened with the project? What do we know about the outcomes of the project at this point? What do you think you will find out?

What were the goals of the HSRC? It's mission/vision?

Did these goals matter to you? In what ways were they important/unimportant?

You mentioned the HSRC wanted to [*insert words the participant used to describe the geoengineering/weather/climate goals of the HSRC*]. I'd like to talk about that some more. Maybe to contextualize this discussion you could first tell me a little bit about your everyday experience with weather?

> What do you think causes the weather?
> Can you tell me about your the kind of relationship you have with weather? What role does weather play in your everyday life?
> Do you hold any religious or spiritual beliefs that affect how you think about the weather and climate?
> Are there any stories or myths that you know about the weather in Haida Gwaii generally?
> What kinds of activities or emotions do you think of when you think about weather?
> Do you have any particularly happy or sad memories of weather?
> What can humans gain knowledge of the weather?
> What is an ideal climate? Is there such thing as an ideal climate?

In the context of all that you've told me about your experience with weather, what do the [*insert words the participant used to describe the geoengineering/weather/climate goals of the HSRC*] goals of the HSRC mean to you?

You mentioned that the HSRC wanted to [*use words that the participant used to describe the geoengineering/weather/climate goals of the HSRC*]. Do you think this is an important goal? In what ways/why not?

You mentioned that the HSRC wanted to [*use words that the participant used to describe the geoengineering/weather/climate goals of the HSRC*]. Are there other ways in which humans might be able to achieve these goals?

Do any of these ideas seem like better or worse ideas to you?

Do you think all people involved in the project conceived of it similarly? Or do people hold different visions of what is could and should involve? Did anyone's visions of the HSRC differ from your own? What goals do you think others were pursuing through their involvement?

Have any other environmental management activities that you've been involved with or witnessed in Haida Gwaii shaped how you see this project?

People have often talked to me about the HSRC in terms of the idea of environmental "stewardship". What does stewardship mean to you? Do you find this term fitting? In what ways/why not?

You've said the words 'nature' and 'natural' many times. Do you feel that the HSRC project in any way changes our relationship with nature? In what ways does it change or stay the same? How do you feel about this?

Why do you think this project has been so controversial on/off island?

Do you think Haida values might be able to inform debate about the HSRC?

What does success look like for this project?

What kinds of things will be needed to make this project a success?

How do you think future people of Haida Gwaii will tell the story of this project?

Is there anything about the HSRC project that you would describe as touching an issue 'close to your heart?

Is there anything you would like to add to what we have discussed today?

Appendix 4.5: Sample Extract from Interview Transcript

[KP = Kate Porter, IR = Interview Respondent]

IR: the first question I asked when he said that they were going to dump the 150 tons of iron ore from Ohio and Baltimore into the ocean, I said isn't it illegal to dump foreign matter into the ocean? It's illegal to dump anything, especially something that's coming from a different country. And he claimed that it wasn't in government jurisdiction, that's why they didn't have to worry about – But I asked them you know, why don't you have environmental people here, DFO and conservation people. Anybody that we could ask question about, because you're telling us it's legal, but you know it would be better if you had officials here that we could ask about it. And he didn't respond to that request. He never fulfilled that request. And every meeting was identical. It talked about the same thing. It was everybody's letting the people down, Ministry of Forests, Department of Fisheries and Oceans and Indian Affairs. Nobody is going to give you any money. So this is your only hope to get a pile of money to look after all your concerns. And now when there was no money to be made because they handled the experiment all wrong in the first place, so there's no baseline information, now all of a sudden they are trying to portray themselves as saviors of the very environment that they told us to violate in the name of greed.

KP: When you say they handled the experiment all wrong in the first place, what do you mean by that?

IR: I don't know if you saw that story in the, I think it was in the Globe and Mail, they said that the student who was on board the vessel got into an argument with Russ George because he felt that they should do baseline information. And Russ George disagreed with that and they just about got into a fistfight, because Russ George didn't think they needed it, they just started dumping and then they will monitor after the fact. But you know that makes the information worthless, because in the first place the area that they chose to do the dumping in was a place that was already frequented by natural algae blooms. So you're supposed to pick an area that is quite neutral, so you can really notice the changes when you do it. And like I said they are supposed to have monitored the area for at least 2 years so that when they put the iron ore in, they can monitor the changes that happen after it was entered into the picture. But they didn't do that. So they are trying to tell the people that this data is really valuable, that they can still get money from that, even though there's no market for the carbon credit scheme that they had. But that's not true. I've checked with people and they say, they know that data would be useless because without that baseline information you know what good would it do? And especially out there in the ocean, with everything moving so violently with the storms and everything. And he also, this is one thing that I found really interesting, that the tsunami happened on the very first day. When I came home from the meeting I handed my husband the information, the sites to check up on the iron fertilization thing. And I said I'll go turn on the tv and see if I missed anything while I was gone. And here flashing across the screen was huge earthquake hits Japan. And I said oh my God it's a sign. Because what they're trying to do is to play God. And it just seemed wrong to me, what they were doing. I never bought any of his back up information about how the dust made salmon stocks multiply and everything, because my family has been working in that canary for years and my Dad has been a fisherman off and on for years, before he passed away. And you know there's years where there were so many fish that my sisters were working until midnight in the cannery, to handle it. And one day they worked for forty days straight, because there were so many salmon. And there were no volcanoes going off or anything during that time you know. And there have also been years where when the fish didn't show up here, but yet they had a boom somewhere else. So it's just like shifting sands you know.

KP: You say 'playing God' seems wrong. Can I ask you to elaborate on that. What's wrong with humans 'playing God'?

IR: because after a while they start to think that they are God. And that they don't have to follow any of the human laws that are there to protect the environment. And that's what I got from them right from the beginning you know. We don't have to ask permission from anybody, because this is

Haida land and we can do whatever we want. And it isn't Haida land, the water belongs to everybody. And as a matter of fact, the land does too. It's just wrong. There was another interesting thing, you know when you think back on a meeting, it's sort of like there's subliminal messages that you neglected to notice. And a young fellow stood up and he asked will there be jobs for us, when this experiment starts? And John Disney said no we've already got a full crew. And this is the meeting to ask the people permission to proceed with the experiment. And yet they already had a full crew. He said, but we can make room for you on there. So you know they already had their crew and their plans all laid out before they even had the meeting.

KP: What's the impact of –

IR: That he was already playing God, right off the bat. You know he didn't wait for permission from the people. He didn't tell them what they were going to do or anything and it also came out, Ken Rea was just a councilor at the time, and the told them that this was the most wonderful thing that he'd ever heard of and he was so excited when he heard about the project, but he was sworn to secrecy…

Appendix 4.6: A List of Some of the Institutional, Social, Political and Cultural Identities Identified by Participants

This list is offered only as an indication of the diversity of the study participants' backgrounds and interests and is not intended to indicate any kind of affiliation with or representation of the institutions listed. This separation was frequently stressed by participants, many of whom took great care to emphasize that they were speaking as individuals, and were not in anyway representing the institutions with which they are affiliated.

Some of the smaller community groups, organisations and institutions, and some of the larger groups and institutions who have very limited representation on island, are not listed in this document to help ensure participant anonymity is preserved.

As is typical of small, remote communities, residents of Haida Gwaii often have very diversified livelihoods, thus participants may have described multiple affiliations or assumed several of these identity labels. Again to ensure anonymity, participants will not be associated with any of these labels in the text, unless understanding particularities of the participants affiliations, backgrounds and personalities is fundamental to the analysis (c.f. Lahsen, 2008). Where personal identities matter for the story (c.f. Lahsen, 2008) such characteristics will be disclosed with the minimal detail necessary for the reader to gain a meaningful understanding of the analysis and only if such disclosures do not risk exposing individual identities.

Participants within the study include:

Haida and non-Haida people who work, have worked for, or have otherwise engaged with:

- The Haida Salmon Restoration Corporation
- The Council of the Haida Nation (including for Haida Fisheries and other CHN environmental and energy boards)
- Old Massett Village Council
- Skidegate Band Council
- Masset Village Council
- Gwaii Haanas National Park / Parks Canada / BC Parks
- Gwaii Trust
- Haida Gwaii Higher Education Society
- BC Ministry of Environment / BC Ministry of Forests, Lands and Natural Resource Operations
- The Haida Heritage Centre
- Council of the Haida Nation Hereditary Chiefs Council
- The David Suzuki Foundation

Haida and non-Haida people who describe themselves as:

- Fishermen
- Artists
- Loggers
- Hunters and gatherers
- Carpenters
- Environmental scientists
- Traditional medicine practitioners
- Retired/unemployed
- Students
- Bird Watchers

Haida and non-Haida people who hold the positions of:

- Hereditary Chiefs, Elders and other community leaders
- Municipal councillors
- Local business owners

Haida and non-Haida people who work or have worked:

- In the renewable energy sector
- In the forestry sector
- In the on-island canneries
- For on-island community development projects
- For local independent environmental organisations
- In local tourism and hospitality activities, including in outdoor pursuits
- In local youth projects

People who are able to:

- Speak fluent Haida or who are learning to speak Haida

People who have fought to:

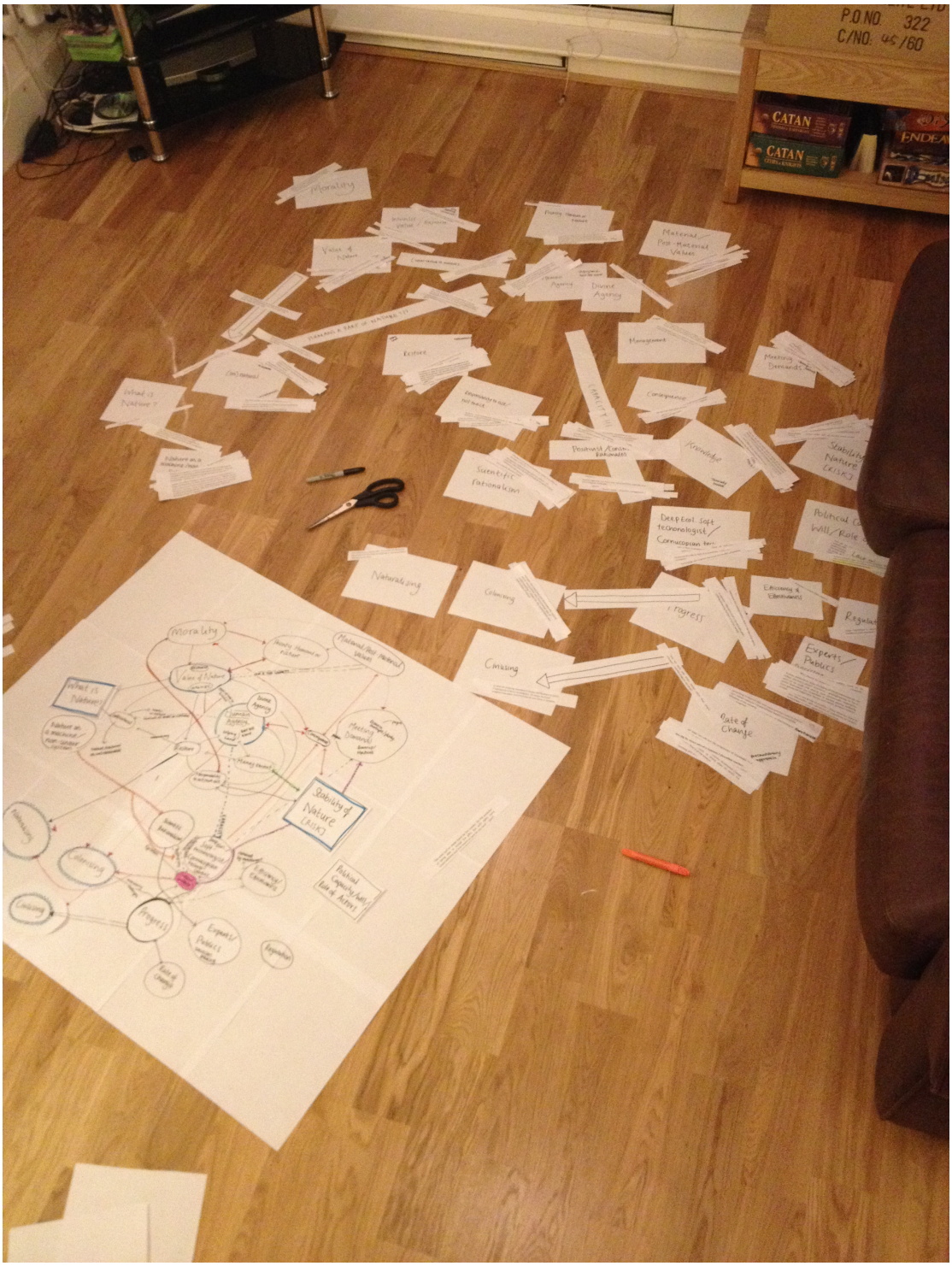
- Resist the Enbridge Pipeline Proposal
- Protect Lyell Island and secure the protection of 51% of Haida Gwaii's land base
- Preserve and restore Haida cultural identity

NB. The plural "people" may be used to refer to a single person.

Appendix 4.7: Participant Recruitment Advert in *The Haida Gwaii Observer*

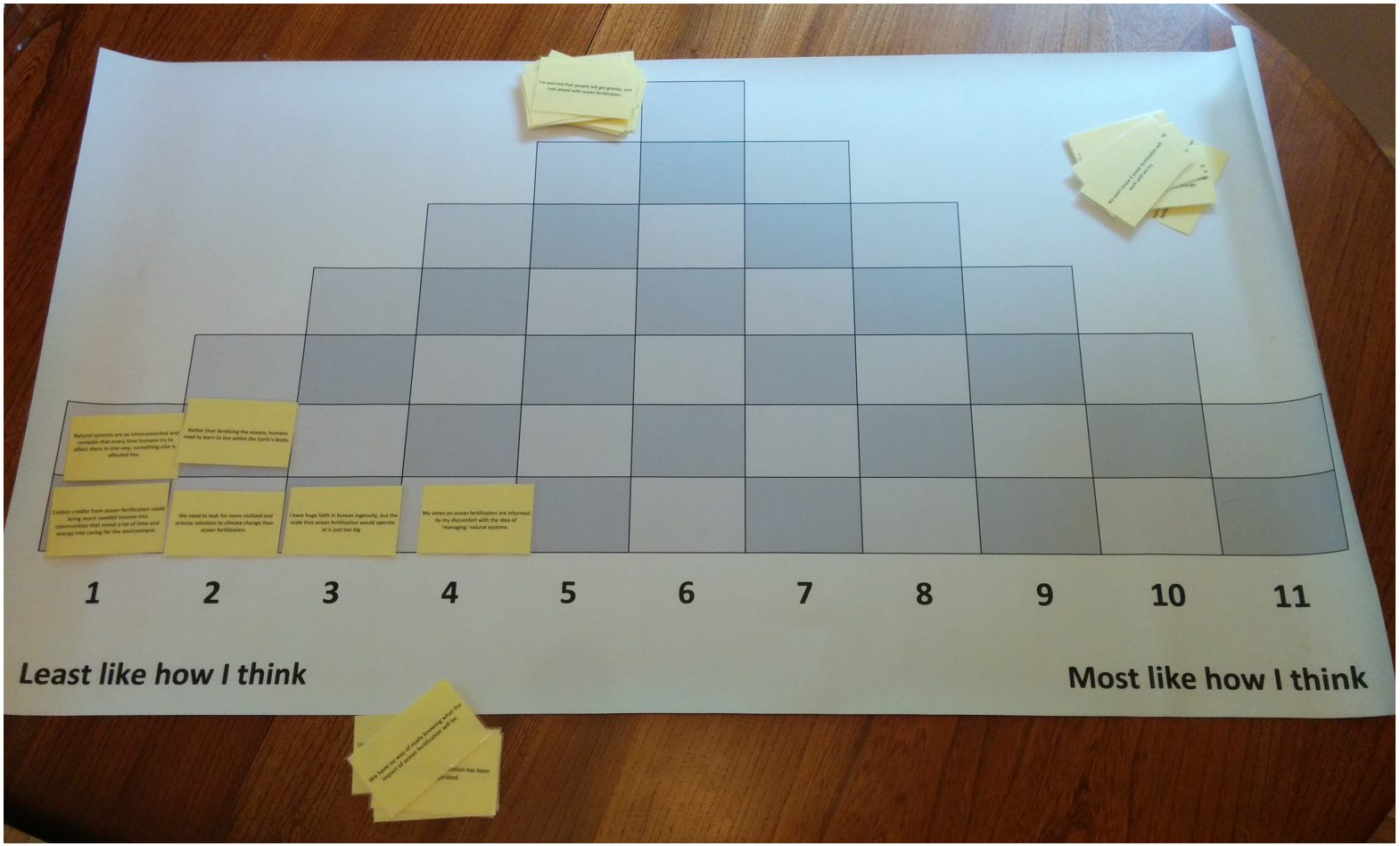
Student Kate Porter from King's College London, England has been in Haida Gwaii exploring perceptions of ocean fertilization following the Haida Salmon Restoration Corporation's iron fertilization experiment. Her research explores how different values and beliefs about the environment interact in the debate on ocean fertilization. She is on island until late April conducting surveys about ocean fertilization. If anyone would like to participate in her research, and share their feelings about ocean fertilization, she would be delighted to hear from you: kate.porter@kcl.ac.uk

Appendix 4.8: Cut and Paste Method of Data Coding, Sorting and Analysis



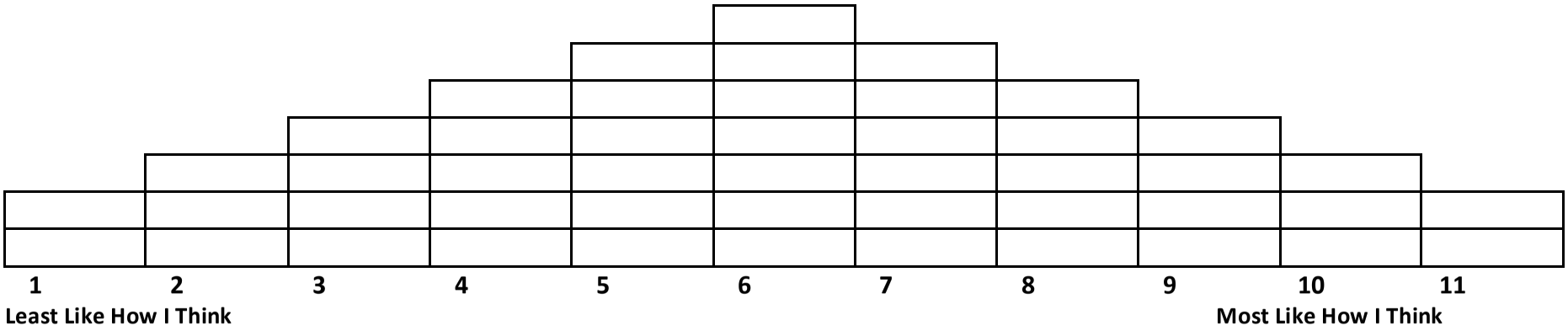
Alongside the goal of salmon restoration, the Haida Salmon Restoration Corporation hopes to sequester carbon dioxide, through ocean fertilization, in order to reduce the scale of human-induced climate change. How do you feel about exploring ocean fertilization to try to sequester carbon dioxide in the ocean? Please sort the provided statements in the order that best describes your point of view.

Appendix 4.10: The Sorting Distribution Chart and Q-Statement Cards

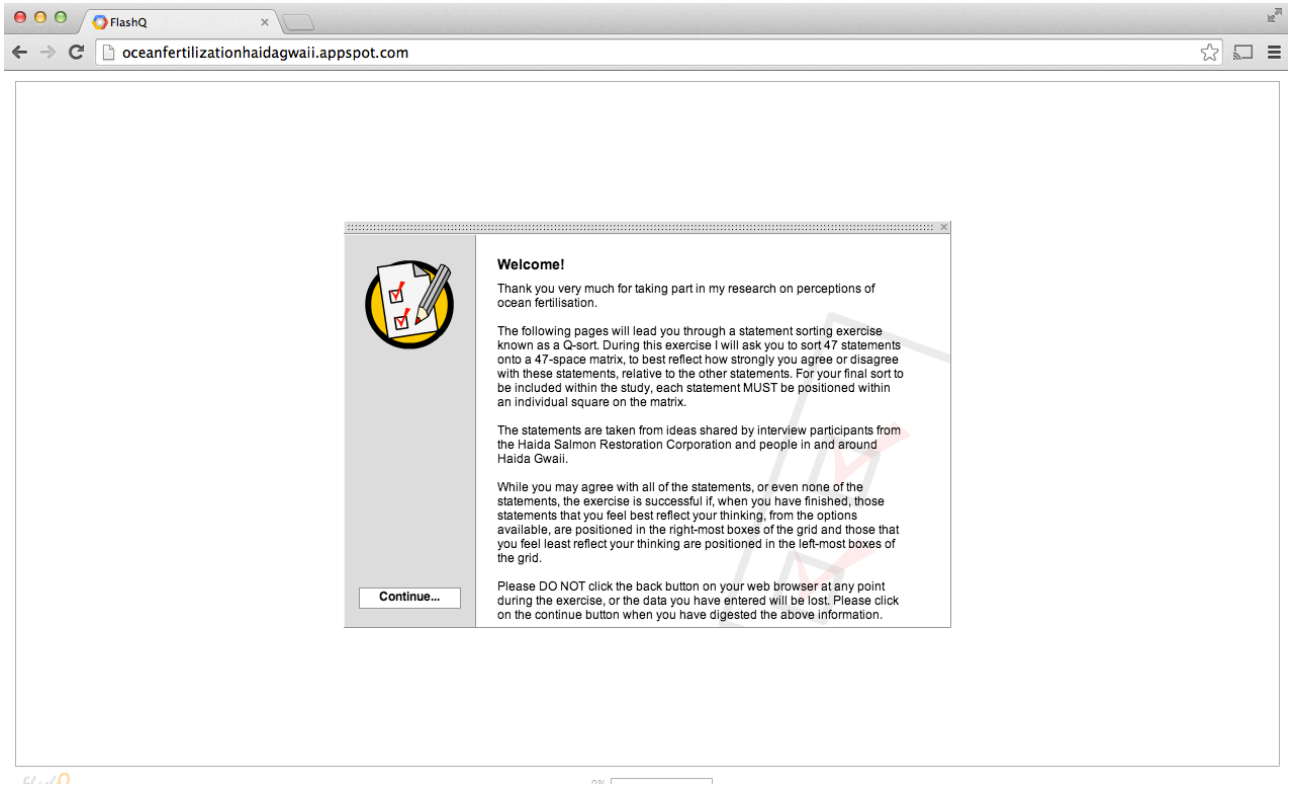


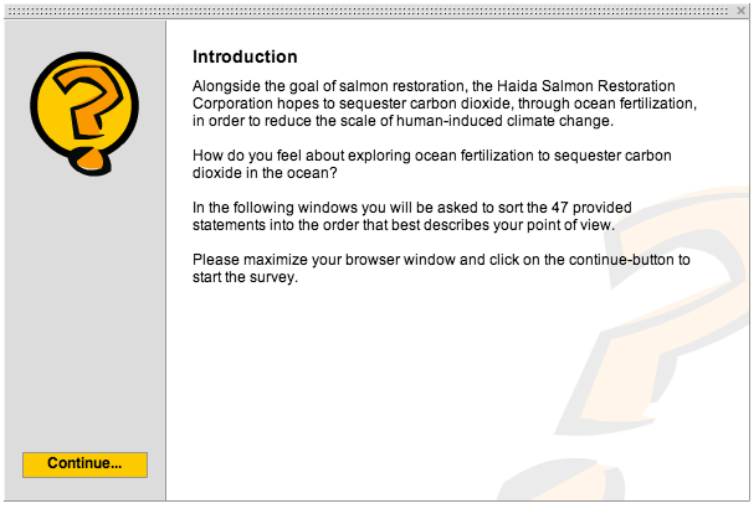
Appendix 4.11: Blank Q-Sort Data Record Page

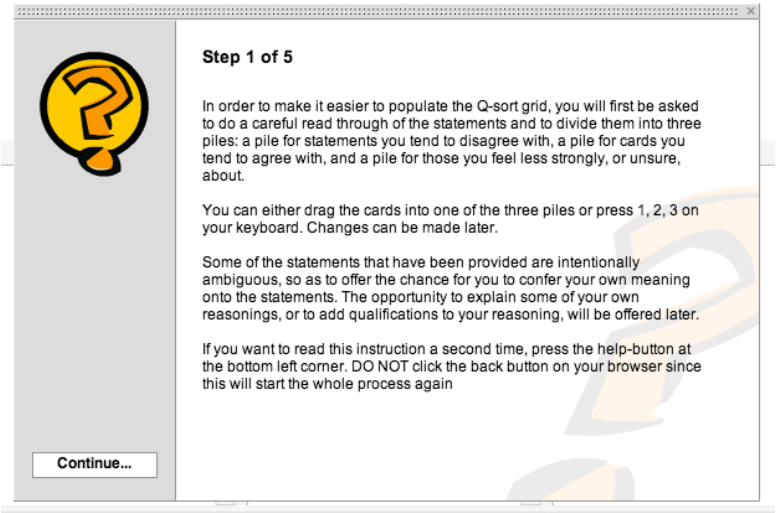
Participant:

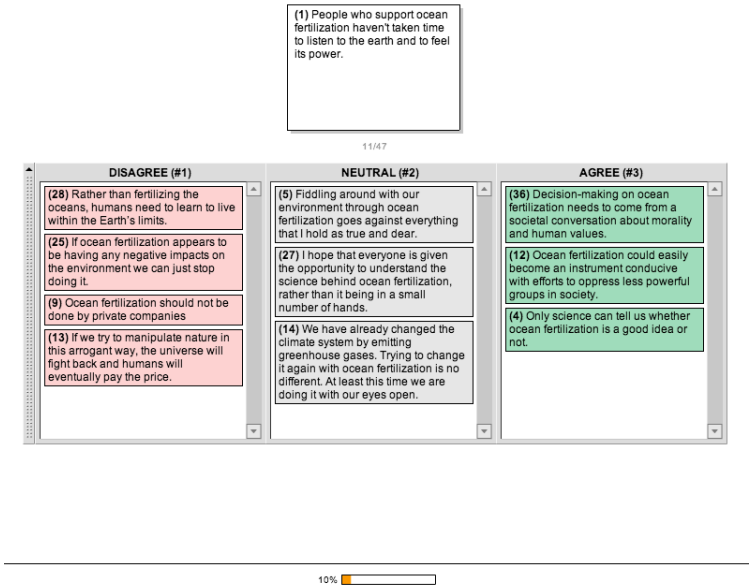


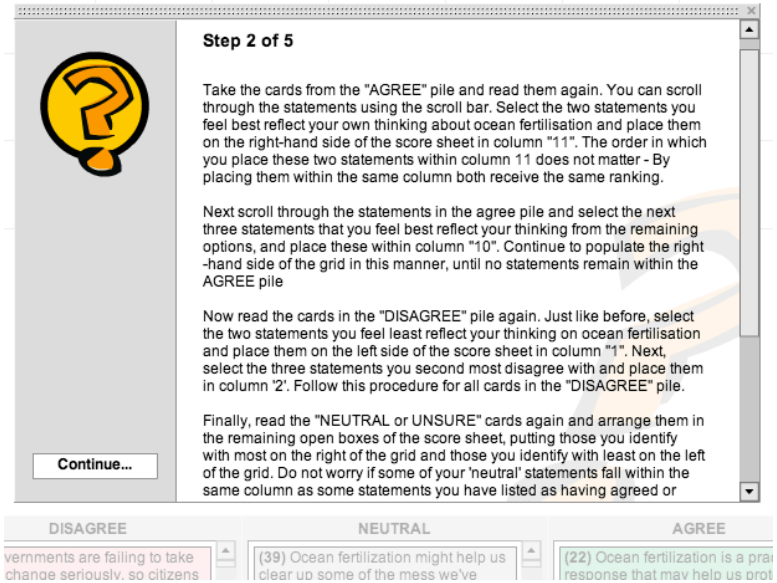
Appendix 4.12: Screenshots of the Online Sorting Process hosted on Google App Engine at http://oceanfertilizationhaidagwaii.appspot.com

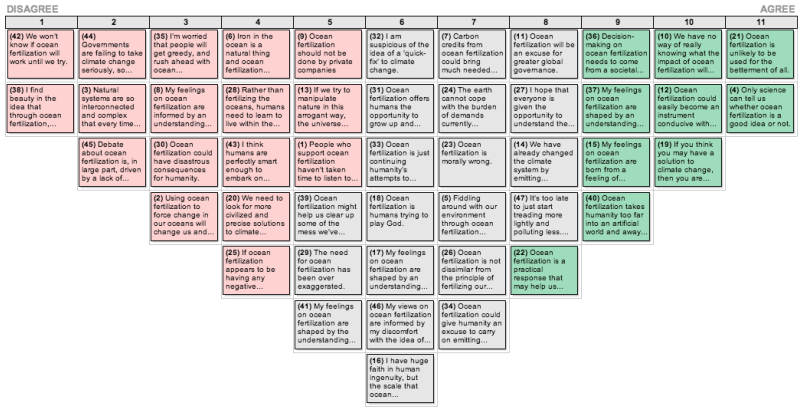


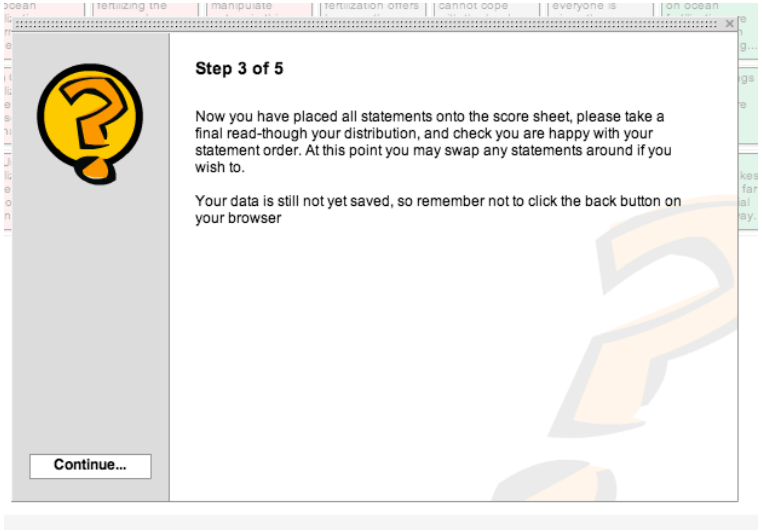

Introduction
Alongside the goal of salmon restoration, the Haida Salmon Restoration Corporation hopes to sequester carbon dioxide, through ocean fertilization, in order to reduce the scale of human-induced climate change.
How do you feel about exploring ocean fertilization to sequester carbon dioxide in the ocean?
In the following windows you will be asked to sort the 47 provided statements into the order that best describes your point of view.
Please maximize your browser window and click on the continue-button to start the survey.
Continue...

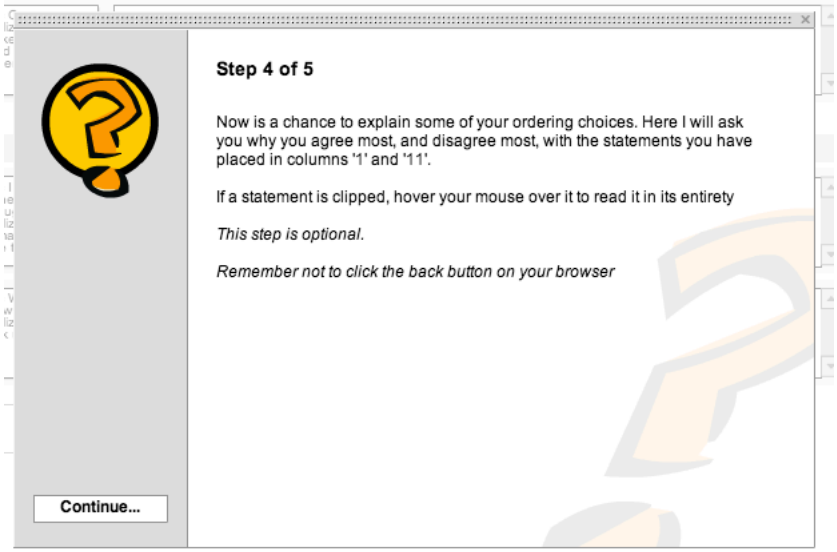

Step 1 of 5
In order to make it easier to populate the Q-sort grid, you will first be asked to do a careful read through of the statements and to divide them into three piles: a pile for statements you tend to disagree with, a pile for cards you tend to agree with, and a pile for those you feel less strongly, or unsure, about.
You can either drag the cards into one of the three piles or press 1, 2, 3 on your keyboard. Changes can be made later.
Some of the statements that have been provided are intentionally ambiguous, so as to offer the chance for you to confer your own meaning onto the statements. The opportunity to explain some of your own reasonings, or to add qualifications to your reasoning, will be offered later.
If you want to read this instruction a second time, press the help-button at the bottom left corner. DO NOT click the back button on your browser since this will start the whole process again
Continue...

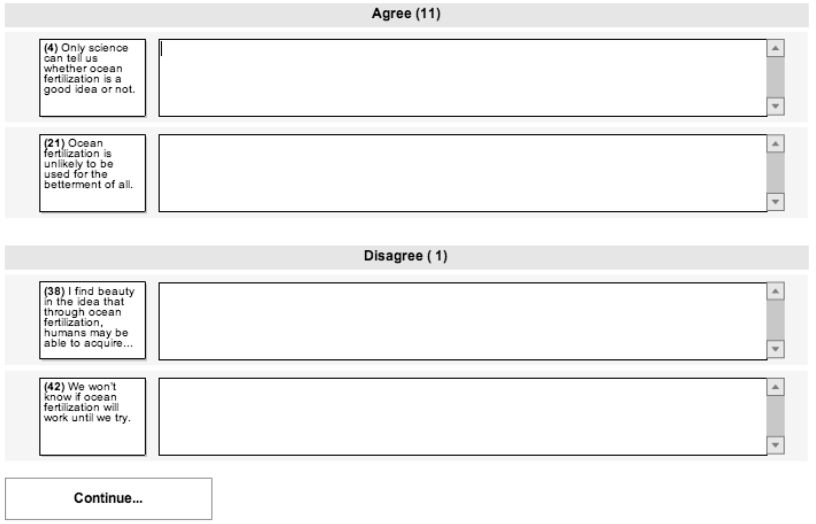

(1) People who support ocean fertilization haven't taken time to listen to the earth and to feel its power.
11/47
DISAGREE (#1)
(28) Rather than fertilizing the oceans, humans need to learn to live within the Earth's limits.
(25) If ocean fertilization appears to be having any negative impacts on the environment we can just stop doing it.
(9) Ocean fertilization should not be done by private companies
(13) If we try to manipulate nature in this arrogant way, the universe will fight back and humans will eventually pay the price.
NEUTRAL (#2)
(5) Fiddling around with our environment through ocean fertilization goes against everything that I hold as true and dear.
(27) I hope that everyone is given the opportunity to understand the science behind ocean fertilization, rather than it being in a small number of hands.
(14) We have already changed the climate system by emitting greenhouse gases. Trying to change it again with ocean fertilization is no different. At least this time we are doing it with our eyes open.
AGREE (#3)
(36) Decision-making on ocean fertilization needs to come from a societal conversation about morality and human values.
(12) Ocean fertilization could easily become an instrument conducive with efforts to oppress less powerful groups in society.
(4) Only science can tell us whether ocean fertilization is a good idea or not.
10%

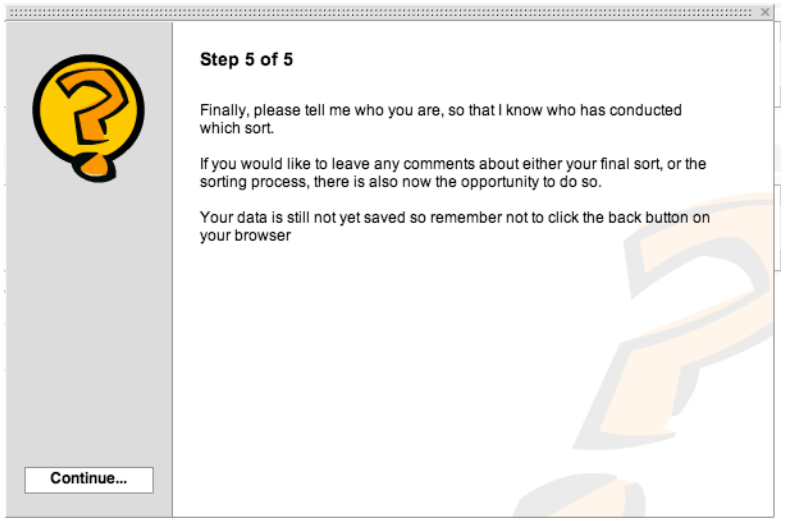

Step 2 of 5
Take the cards from the "AGREE" pile and read them again. You can scroll through the statements using the scroll bar. Select the two statements you feel best reflect your own thinking about ocean fertilisation and place them on the right-hand side of the score sheet in column "11". The order in which you place these two statements within column 11 does not matter - By placing them within the same column both receive the same ranking.
Next scroll through the statements in the agree pile and select the next three statements that you feel best reflect your thinking from the remaining options, and place these within column "10". Continue to populate the right -hand side of the grid in this manner, until no statements remain within the AGREE pile
Now read the cards in the "DISAGREE" pile again. Just like before, select the two statements you feel least reflect your thinking on ocean fertilisation and place them on the left side of the score sheet in column "1". Next, select the three statements you second most disagree with and place them in column '2'. Follow this procedure for all cards in the "DISAGREE" pile.
Finally, read the "NEUTRAL or UNSURE" cards again and arrange them in the remaining open boxes of the score sheet, putting those you identify with most on the right of the grid and those you identify with least on the left of the grid. Do not worry if some of your 'neutral' statements fall within the same column as some statements you have listed as having agreed or
Continue...
DISAGREE
NEUTRAL
AGREE
vernments are failing to take
change seriously, so citizens
(39) Ocean fertilization might help us
clear up some of the mess we've
(22) Ocean fertilization is a pra
response that may help us prot

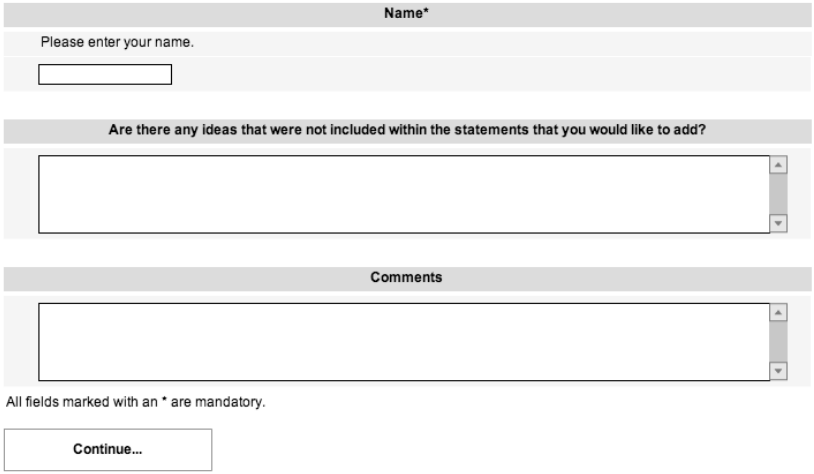

DISAGREE
AGREE
1
2
3
4
5
6
7
8
9
10
11
(42) We won't know if ocean fertilization will work until we try.
(44) Governments are failing to take climate change seriously, so...
(35) I'm worried that people will get greedy, and rush ahead with ocean...
(6) Iron in the ocean is a natural thing and ocean fertilization...
(9) Ocean fertilization should not be done by private companies
(32) I am suspicious of the idea of a 'quick-fix' to climate change.
(7) Carbon credits from ocean fertilization could bring much needed...
(11) Ocean fertilization will be an excuse for greater global governance.
(36) Decision-making on ocean fertilization needs to come from a societal...
(10) We have no way of really knowing what the impact of ocean fertilization will...
(21) Ocean fertilization is unlikely to be used for the betterment of all.
(38) I find beauty in the idea that through ocean fertilization,...
(3) Natural systems are so interconnected and complex that every time...
(8) My feelings on ocean fertilization are informed by an understanding...
(28) Rather than fertilizing the oceans, humans need to learn to live within the...
(13) If we try to manipulate nature in this arrogant way, the universe...
(31) Ocean fertilization offers humans the opportunity to grow up and...
(24) The earth cannot cope with the burden of demands currently...
(27) I hope that everyone is given the opportunity to understand the...
(37) My feelings on ocean fertilization are shaped by an understanding...
(12) Ocean fertilization could easily become an instrument conducive with...
(4) Only science can tell us whether ocean fertilization is a good idea or not.
(45) Debate about ocean fertilization is, in large part, driven by a lack of...
(30) Ocean fertilization could have disastrous consequences for humanity.
(43) I think humans are perfectly smart enough to embark on...
(1) People who support ocean fertilization haven't taken time to listen to...
(33) Ocean fertilization is just continuing humanity's attempts to...
(23) Ocean fertilization is morally wrong.
(14) We have already changed the climate system by emitting...
(15) My feelings on ocean fertilization are born from a feeling of...
(19) If you think you may have a solution to climate change, then you are...
(2) Using ocean fertilization to force change in our oceans will change us and...
(20) We need to look for more civilized and precise solutions to climate...
(39) Ocean fertilization might help us clear up some of the mess we've...
(18) Ocean fertilization is humans trying to play God.
(5) Fiddling around with our environment through ocean fertilization...
(47) It's too late to just start treading more lightly and polluting less...
(40) Ocean fertilization takes humanity too far into an artificial world and away...
(25) If ocean fertilization appears to be having any negative...
(29) The need for ocean fertilization has been over exaggerated.
(17) My feelings on ocean fertilization are shaped by an understanding...
(26) Ocean fertilization is not dissimilar from the principle of fertilizing our...
(22) Ocean fertilization is a practical response that may help us...
(41) My feelings on ocean fertilization are shaped by the understanding...
(46) My views on ocean fertilization are informed by my discomfort with the idea of...
(34) Ocean fertilization could give humanity an excuse to carry on emitting...
(16) I have huge faith in human ingenuity, but the scale that ocean...

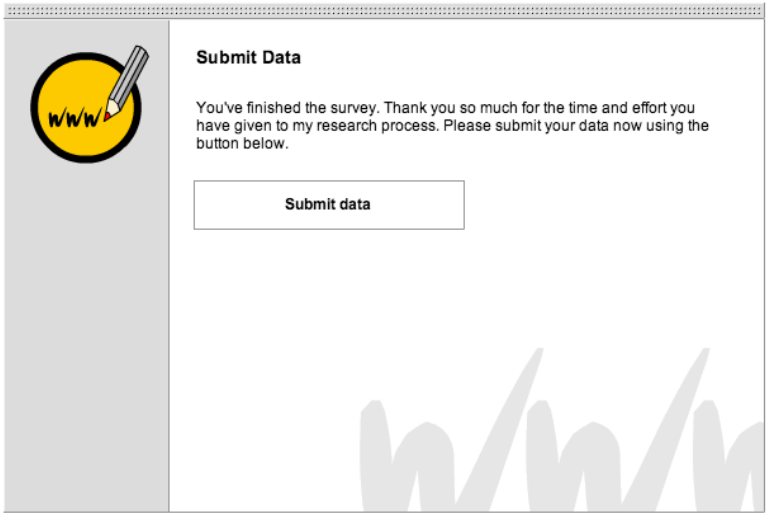

Step 3 of 5
Now you have placed all statements onto the score sheet, please take a final read-though your distribution, and check you are happy with your statement order. At this point you may swap any statements around if you wish to.
Your data is still not yet saved, so remember not to click the back button on your browser
Continue...


Step 4 of 5
Now is a chance to explain some of your ordering choices. Here I will ask you why you agree most, and disagree most, with the statements you have placed in columns '1' and '11'.
If a statement is clipped, hover your mouse over it to read it in its entirety
This step is optional.
Remember not to click the back button on your browser
Continue...


Agree (11)
(4) Only science can tell us whether ocean fertilization is a good idea or not.
(21) Ocean fertilization is unlikely to be used for the betterment of all.
Disagree (1)
(38) I find beauty in the idea that through ocean fertilization, humans may be able to acquire...
(42) We won't know if ocean fertilization will work until we try.
Continue...


Step 5 of 5
Finally, please tell me who you are, so that I know who has conducted which sort.
If you would like to leave any comments about either your final sort, or the sorting process, there is also now the opportunity to do so.
Your data is still not yet saved so remember not to click the back button on your browser
Continue...


Name*
Please enter your name.
Are there any ideas that were not included within the statements that you would like to add?
Comments
All fields marked with an * are mandatory.
Continue...


Submit Data
You've finished the survey. Thank you so much for the time and effort you have given to my research process. Please submit your data now using the button below.
Submit data

Appendix 4.13: Example Interview Information Sheet

Information Sheet

I am a PhD student from King's College London (formerly from the University of East Anglia).

My research explores how different beliefs and values shape how people form opinions about the desirability and feasibility of different forms of environmental management.

Specifically, I have been exploring perceptions of ocean fertilization following the Haida Salmon Restoration Corporation's experiment in 2012.

This was an appropriate case study for my research since through the Haida Salmon Restoration Corporation, different actors are revealing diverse perspectives about the role that ocean fertilization could and should play in the future management of our environment.

You have been selected to participate in this study since I believe your opinions will add valuable insight to my research. My interest is simply to understand what values and beliefs influence your response to the Haida Salmon Restoration Corporation's ocean fertilization project, so there are no right or wrong answers, and this is not a test.

At all times during the interview you are free to stop participating if you do not wish to continue. You are also free to decline to answer a particular question, to change an answer, or to retract a statement at any time. If at any point during the interview you wish to take a break, then please just let me know.

If you require more information about this research, please do not hesitate to contact me using the contact details provided below.

Your assistance with this project is greatly appreciated.

Researcher: Kate Elizabeth Porter

Visiting Scholar
Department of Geography
University of British Columbia
1984 West Mall
Vancouver, BC
V6T 1Z2
Canada

PhD researcher
Department of Geography,
School of Social Science and Public Policy,
King's College London,
Strand
London
WC2R 2LS
United Kingdom
kate.porter@kcl.ac.uk
+44 (0) 7725 55858

Appendix 4.14: Example Interview Consent Form

Kate Elizabeth Porter
Department of Geography,
School of Social Science and
Public Policy,
King's College London,
Strand
London
WC2R 2LS
United Kingdom
kate.porter@kcl.ac.uk
+44 (0) 7725 558583

Interview Consent Form

Name: _____ Date: _____

Postal Address: _____

_____

Email: _____

Telephone number(s): _____

I, the undersigned, agree to be interviewed by Kate Porter about my perceptions of ocean fertilization and the Haida Salmon Restoration Corporation.

On the understanding that what I say will be reported anonymously, permission is given for Kate to use the words and information contained in this interview in the form of direct quotations and paraphrasing as part of her thesis research.

I do / do not (please delete as appropriate) give permission for the interview to be recorded. I understand that, should I consent to the interview being recorded, a copy of the recording, or a written transcript of the interview, will be made available to me if requested.

I understand that I have the right to discontinue the interview at any time, to change an answer given or to alter or retract statements made.

I understand that all the information I provide to Kate will be anonymized and stored securely in confidential records to which only Kate and her PhD supervisors will be granted access.

I give permission for the findings of this interview to be reported in Kate's PhD thesis and in any papers and presentations that may arise from this research and in any further research that may result from the findings in Kate's PhD thesis

Signed: _____
(Interviewee)

Date: _____

Appendix 4.15: Example Q-Sort Information Sheet

Information Sheet

I am a PhD student from King's College London (formerly from the University of East Anglia).

My research explores different beliefs and values surrounding how people form opinions about the desirability and feasibility of climate engineering.

Specifically, I have been exploring perceptions of ocean fertilization following the Haida Salmon Restoration Corporation's experiment in 2012.

This was an appropriate case study for my research since within this context, different actors are revealing diverse perspectives about the role that climate engineering could and should play in the future management of our environment.

You have been selected to participate in this study since I believe your opinions will add valuable insight to my research. My interest is simply to understand what values and beliefs influence your response to the idea of climate engineering, so there are no right or wrong answers, and this is not a test.

During this interview I will ask you to conduct a statement sorting exercise. This will involve sorting 47 statements, reflecting diverse reactions to the idea of ocean fertilization, onto a grid in the pattern that best describes how you feel about ocean fertilization.

While you sort these statements I will ask you to think out loud, so that I can best understand your perspective.

If you require more information about this research, please do not hesitate to contact me using the contact details provided below.

Your assistance with this project is greatly appreciated.

Researcher: Kate Elizabeth Porter

Visiting Scholar
Department of Geography
University of British Columbia
1984 West Mall
Vancouver, BC
V6T 1Z2
Canada

PhD researcher
Department of Geography,
School of Social Science and Public Policy,
King's College London,
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+44 (0) 7725 558583

Appendix 4.16: Example Q-Sort Consent Form

Kate Elizabeth Porter
Department of Geography,
School of Social Science and
Public Policy,
King's College London,
Strand
London
WC2R 2LS
United Kingdom
kate.porter@kcl.ac.uk
+44 (0) 7725 558583

Interview Consent Form

Name: _____ Date: _____

Postal Address: _____

_____

Email: _____

Telephone number(s): _____

I, the undersigned, agree to be interviewed by Kate Porter about my perceptions of ocean fertilization and the Haida Salmon Restoration Corporation and agree to have the results from a statement sorting exercise (Q-sort) recorded.

On the understanding that what I say will be reported anonymously, permission is given for Kate to use the words and information contained in this interview in the form of direct quotations and paraphrasing as part of her thesis research.

I do / do not (please delete as appropriate) give permission for the interview to be recorded. I understand that, should I consent to the interview being recorded, a copy of the recording, or a written transcript of the interview, will be made available to me if requested.

I understand that I have the right to discontinue the interview at any time, to change an answer given or to alter or retract statements made.

I understand that all the information I provide to Kate will be anonymized and stored securely in confidential records to which only Kate and her PhD supervisors will be granted access.

I give permission for the findings of this interview to be reported in Kate's PhD thesis and in any papers and presentations that may arise from this research and in any further research that may result from the findings in Kate's PhD thesis

Signed: _____ Date: _____
(Interviewee)

Appendix 7.1: Exemplary Q-sort Estimated Factor Arrays

Factor 1a.

Based on a factor estimate built from the sorts of Participant 2 Katherine Young, Participant 4 Marlene Hawkins, Participant 8 Noel Townsend, Participant 11 Harry Doyle and Participant 19 Charlotte Elliott (all loading at 99% significance).

					46					
				29	45	37				
			44	26	34	33	41			
		47	19	25	27	15	40	36		
	39	38	17	24	21	8	35	32	30	
43	7	31	14	16	11	2	28	20	23	18
42	6	22	4	12	9	1	10	3	5	13
-5	**-4**	**-3**	**-2**	**-1**	**0**	**+1**	**+2**	**+3**	**+4**	**+5**

Least like how I think **Most like how I think**

Factor 1b.

Based on a factor estimate built from the sorts of Participant 1 Russell Anderson, Participant 5 Brent Morton, Participant 10 Raymond Wallace, Participant 14 Joe Newman, Participant 21 Susan Hughes, Participant 24 Rob Peters and Participant 26 Ryan Carr (all loading at 99% significance).

					46					
				34	36	45				
			40	32	35	44	27			
		30	33	20	31	43	26	39		
	18	29	24	12	28	41	17	22	47	
23	13	21	16	10	15	37	6	19	38	42
5	1	9	8	2	11	7	3	14	4	25
-5	**-4**	**-3**	**-2**	**-1**	**0**	**+1**	**+2**	**+3**	**+4**	**+5**

Least like how I think **Most like how I think**

Factor 2.

Based on a factor estimate built from the sorts of Participant 3 Theresa Page, Participant 13 Gary Bennett, Participant 16 Lewis Fletcher, Participant 18 Max Cannon, Participant 20 Ross Poole, Participant 22 Lloyd Jones and Participant 23 Ruth Carter (all loading at 99% significance)

					45					
				42	44	40				
			47	29	33	36	37			
		38	39	22	16	35	34	46		
	43	26	23	18	10	13	30	27	41	
31	25	11	14	17	7	8	21	24	32	28
19	12	6	1	2	5	4	15	9	20	3
-5	**-4**	**-3**	**-2**	**-1**	**0**	**+1**	**+2**	**+3**	**+4**	**+5**

Least like how I think **Most like how I think**

Appendix 7.2: Factor interpretation crib sheet for Factor 1a

Items ranked at +5	
13.	If we try to manipulate nature in this arrogant way, the universe will fight back and humans will eventually pay the price **
18.	Ocean fertilization is humans trying to play God **
Items ranked at +4	
5.	Fiddling around with our environment through ocean fertilization goes against everything that I hold as true and dear **
23.	Ocean fertilization is morally wrong **
30.	Ocean fertilization could have disastrous consequences for humanity *
Other items ranked higher in the Factor 1 array than in the other factor arrays	
36.	Decision-making on ocean fertilization needs to come from a societal conversation about morality and human values (+3)
10.	We have no way of really knowing what the impact of ocean fertilization will be (+2**)
35.	I'm worried that people will get greedy, and rush ahead with ocean fertilization (+2)
40.	Ocean fertilization takes humanity too far into an artificial world and away from the natural order of things (+2)
1.	People who support ocean fertilization haven't taken time to listen to the earth and to feel its power (+1**)
2.	Using ocean fertilization to force change in our oceans will change us and we will lose our connection to the earth (+1*)
8.	My feelings on ocean fertilization are informed by an understanding that the natural world needs us to step back and leave it alone (+1 Ξ^3)
33.	Ocean fertilization is just continuing humanity's attempts to dominate and exploit nature (+1)
11.	Ocean fertilization will be an excuse for greater global governance (0 Ξ^2)
12.	Ocean fertilization could easily become an instrument conducive with efforts to oppress less powerful groups in society (-1 Ξ^2)
Other items ranked lower in the Factor 1 array than in the other factor arrays	
37.	My feelings on ocean fertilization are shaped by an understanding that human and non-human worlds are entangled. Trying to separate them is meaningless (+1 Ξ^2)
27.	I hope that everyone is given the opportunity to understand the science behind ocean fertilization, rather than it being in a small number of hands (0*)
45.	Debate about ocean fertilization is, in large part, driven by a lack of public education (0 Ξ^3)
46.	My views on ocean fertilization are informed by my discomfort with the idea of 'managing' natural systems (0 Ξ^2)
29.	The need for ocean fertilization has been over exaggerated (-1 Ξ^3)
4.	Only science can tell us whether ocean fertilization is a good idea or not (-2**)
14.	We have already changed the climate system by emitting greenhouse gases. Trying to change it again with ocean fertilization is no different. At least this time we are doing it with our eyes open (-2 Ξ^3)
17.	My feelings on ocean fertilization are shaped by an understanding that if we are to save the world from dangerous climate change, we need to think big and do so quickly (-2)
44.	Governments are failing to take climate change seriously, so citizens need to develop their own solutions, such as ocean fertilization (-2**)
22	Ocean fertilization is a practical response that may help us protect what we have left (-3**)
38.	I find beauty in the idea that through ocean fertilization, humans may be able to acquire the means of stewarding the planet through the challenge of climate change (-3 Ξ^3)
47.	It's too late to just start treading more lightly and polluting less. We need ideas like ocean fertilization to undo some of the harm we've already caused (-3)

Items ranked at -4	
6.	Iron in the ocean is a natural thing and ocean fertilization mimics the natural rhythms of nature
7.	Carbon credits from ocean fertilization could bring much needed income into communities that invest a lot of time and energy into caring for the environment **
39.	Ocean fertilization might help us clear up some of the mess we've made, to help bring the Earth back to health *
Items ranked at -5	
42	We won't know if ocean fertilization will work until we try **
43	I think humans are perfectly smart enough to embark on ocean fertilization
Distinguishing statements (p < .05) not captured elsewhere in this crib sheet	
28.	Rather than fertilizing the oceans, humans need to learn to live within the Earth's limits (2**)
9	Ocean fertilization should not be done by private companies (0**)
21.	Ocean fertilization is unlikely to be used for the betterment of all (0*)
25.	If ocean fertilization appears to be having any negative impacts on the environment we can just stop doing it (-1**)

An asterisk indicates a distinguishing statement at (p < .05) and a double asterisk indicates a distinguishing statements at (p < .01). Distinguishing statements are statements that are placed in a statistically different position on the Q-sort grid by participants that load onto a given factor, to where participants that load on other factors have placed the same statement.

Ξ Indicates that a statement's rank is tied with that of another factor. The factor it is tied with is identified through numerical superscript.

Appendix 7.3: Factor interpretation crib sheet for Factor 1b

Items ranked at +5	
25.	If ocean fertilization appears to be having any negative impacts on the environment we can just stop doing it **
42.	We won't know if ocean fertilization will work until we try **
Items ranked at +4	
4.	Only science can tell us whether ocean fertilization is a good idea or not **
38.	I find beauty in the idea that through ocean fertilization, humans may be able to acquire the means of stewarding the planet through the challenge of climate change **
47	It's too late to just start treading more lightly and polluting less. We need ideas like ocean fertilization to undo some of the harm we've already caused **
Other items ranked higher in the Factor 2 array than in the other factor arrays	
14.	We have already changed the climate system by emitting greenhouse gases. Trying to change it again with ocean fertilization is no different. At least this time we are doing it with our eyes open (+3**)
19.	If you think you may have a solution to climate change, then you are morally obligated to pursue it. Ocean fertilization is a good example of this (+3**)
22.	Ocean fertilization is a practical response that may help us protect what we have left (+3**)
39.	Ocean fertilization might help us clear up some of the mess we've made, to help bring the Earth back to health (+3**)
6.	Iron in the ocean is a natural thing and ocean fertilization mimics the natural rhythms of nature (+2**)
17.	My feelings on ocean fertilization are shaped by an understanding that if we are to save the world from dangerous climate change, we need to think big and do so quickly (+2**)
26.	Ocean fertilization is not dissimilar from the principle of fertilizing our crops, to meet the demands of a rapidly growing global population (+2**)
7.	Carbon credits from ocean fertilization could bring much needed income into communities that invest a lot of time and energy into caring for the environment (+1**)
43.	I think humans are perfectly smart enough to embark on ocean fertilization (+1**)
44.	Governments are failing to take climate change seriously, so citizens need to develop their own solutions, such as ocean fertilization (+1*)
45.	Debate about ocean fertilization is, in large part, driven by a lack of public education (+1*)
11.	Ocean fertilization will be an excuse for greater global governance (0 Ξ[1])
31.	Ocean fertilization offers humans the opportunity to grow up and take responsibility for the harm they have caused the environment (0**)
12.	Ocean fertilization could easily become an instrument conducive with efforts to oppress less powerful groups in society (-1 Ξ[1])
Other items ranked lower in the Factor 2 array than in the other factor arrays	
3.	Natural systems are so interconnected and complex that every time humans try to affect them in one way, something else is affected too (+2)
37.	My feelings on ocean fertilization are shaped by an understanding that human and non-human worlds are entangled. Trying to separate them is meaningless (+1 Ξ[1])
41.	My feelings on ocean fertilization are shaped by the understanding that if you take care of the Earth, it is going to take care of you (+1)
15.	My feelings on ocean fertilization are born from a feeling of connection to the earth and to other forms of life (0)
28.	Rather than fertilizing the oceans, humans need to learn to live within the Earth's limits (0**)

35.	I'm worried that people will get greedy, and rush ahead with ocean fertilization (0)
36.	Decision-making on ocean fertilization needs to come from a societal conversation about morality and human values (0)
46.	My views on ocean fertilization are informed by my discomfort with the idea of 'managing' natural systems (0)
2.	Using ocean fertilization to force change in our oceans will change us and we will lose our connection to the earth (-1 Ξ[3])
10.	We have no way of really knowing what the impact of ocean fertilization will be (-1)
20.	We need to look for more civilized and precise solutions to climate change than ocean fertilization (-1**)
32.	I am suspicious of the idea of a 'quick-fix' to climate change (-1**)
34.	Ocean fertilization could give humanity an excuse to carry on emitting greenhouse gases, meaning we miss the opportunity to transform our energy and economic systems (-1**)
8.	My feelings on ocean fertilization are informed by an understanding that the natural world needs us to step back and leave it alone (-2**)
16.	I have huge faith in human ingenuity, but the scale that ocean fertilization would operate at is just too big (-2**)
24.	The earth cannot cope with the burden of demands currently placed on it. No technological fix, ocean fertilization included, will get us around that fact (-2)
33.	Ocean fertilization is just continuing humanity's attempts to dominate and exploit nature (-2**)
40.	Ocean fertilization takes humanity too far into an artificial world and away from the natural order of things (-2**)
9.	Ocean fertilization should not be done by private companies (-3**)
21.	Ocean fertilization is unlikely to be used for the betterment of all (-3**)
29.	The need for ocean fertilization has been over exaggerated (-3**)
30.	Ocean fertilization could have disastrous consequences for humanity (-3**)
Items ranked at -4	
1.	People who support ocean fertilization haven't taken time to listen to the earth and to feel its power
13.	If we try to manipulate nature in this arrogant way, the universe will fight back and humans will eventually pay the price **
18.	Ocean fertilization is humans trying to play God **
Items ranked at -5	
5.	Fiddling around with our environment through ocean fertilization goes against everything that I hold as true and dear **
23.	Ocean fertilization is morally wrong **
Distinguishing statements (p < .05) not captured elsewhere in this crib sheet: N/A	

An asterisk indicates a distinguishing statement at (p < .05) and a double asterisk indicates a distinguishing statements at (p < .01). Distinguishing statements are statements that are placed in a statistically different position on the Q-sort grid by participants that load onto a given factor, to where participants that load on other factors have placed the same statement.

Ξ Indicates that a statement's rank is tied with that of another factor; the factor it is tied with is identified through numerical superscript.

Appendix 7.4: Factor interpretation crib sheet for Factor 2

Items ranked at +5	
3.	Natural systems are so interconnected and complex that every time humans try to affect them in one way, something else is affected too **
28.	Rather than fertilizing the oceans, humans need to learn to live within the Earth's limits **
Items ranked at +4	
20.	We need to look for more civilized and precise solutions to climate change than ocean fertilization
32.	I am suspicious of the idea of a 'quick-fix' to climate change
41.	My feelings on ocean fertilization are shaped by the understanding that if you take care of the Earth, it is going to take care of you *
Other items ranked higher in the Factor 3 array than in the other factor arrays	
9.	Ocean fertilization should not be done by private companies (+3**)
24.	The earth cannot cope with the burden of demands currently placed on it. No technological fix, ocean fertilization included, will get us around that fact (+3**)
27.	I hope that everyone is given the opportunity to understand the science behind ocean fertilization, rather than it being in a small number of hands (+3)
46.	My views on ocean fertilization are informed by my discomfort with the idea of 'managing' natural systems (+3**)
15.	My feelings on ocean fertilization are born from a feeling of connection to the earth and to other forms of life (+2)
21.	Ocean fertilization is unlikely to be used for the betterment of all (+2*)
34.	Ocean fertilization could give humanity an excuse to carry on emitting greenhouse gases, meaning we miss the opportunity to transform our energy and economic systems (+2)
37.	My feelings on ocean fertilization are shaped by an understanding that human and non-human worlds are entangled. Trying to separate them is meaningless (+2)
8.	My feelings on ocean fertilization are informed by an understanding that the natural world needs us to step back and leave it alone (+1 Ξ^1)
16.	I have huge faith in human ingenuity, but the scale that ocean fertilization would operate at is just too big (0)
29.	The need for ocean fertilization has been over exaggerated (-1 Ξ^1)
Other items ranked lower in the Factor 2 array than in the other factor arrays	
45.	Debate about ocean fertilization is, in large part, driven by a lack of public education (0 Ξ^1)
2.	Using ocean fertilization to force change in our oceans will change us and we will lose our connection to the earth (-1 Ξ^2)
11.	Ocean fertilization will be an excuse for greater global governance (-3**)
14.	We have already changed the climate system by emitting greenhouse gases. Trying to change it again with ocean fertilization is no different. At least this time we are doing it with our eyes open (-2 Ξ^1)
21.	Ocean fertilization is unlikely to be used for the betterment of all (+2*)
24.	The earth cannot cope with the burden of demands currently placed on it. No technological fix, ocean fertilization included, will get us around that fact (+3**)
29.	The need for ocean fertilization has been over exaggerated (-1 Ξ^1)
38.	I find beauty in the idea that through ocean fertilization, humans may be able to acquire the means of stewarding the planet through the challenge of climate change (-3 Ξ^1)
Items ranked at -4	
12.	Ocean fertilization could easily become an instrument conducive with efforts to oppress less powerful groups in society
25.	If ocean fertilization appears to be having any negative impacts on the environment we

	can just stop doing it **
43.	I think humans are perfectly smart enough to embark on ocean fertilization
Items ranked at -5	
19.	If you think you may have a solution to climate change, then you are morally obligated to pursue it. Ocean fertilization is a good example of this
31.	Ocean fertilization offers humans the opportunity to grow up and take responsibility for the harm they have caused the environment
Distinguishing statements (p < .05) not captured elsewhere in this crib sheet	
4.	Only science can tell us whether ocean fertilization is a good idea or not (+1**)
5.	Fiddling around with our environment through ocean fertilization goes against everything that I hold as true and dear (0**)
7.	Carbon credits from ocean fertilization could bring much needed income into communities that invest a lot of time and energy into caring for the environment (0**)
13.	If we try to manipulate nature in this arrogant way, the universe will fight back and humans will eventually pay the price (1**)
18.	Ocean fertilization is humans trying to play God (-1**)
22.	Ocean fertilization is a practical response that may help us protect what we have left (-1**)
23.	Ocean fertilization is morally wrong (-2**)
30.	Ocean fertilization could have disastrous consequences for humanity (+2*)
39.	Ocean fertilization might help us clear up some of the mess we've made, to help bring the Earth back to health (-2*)
44.	Governments are failing to take climate change seriously, so citizens need to develop their own solutions, such as ocean fertilization (0*)

An asterisk indicates a distinguishing statement at (p < .05) and a double asterisk indicates a distinguishing statements at (p < .01). Distinguishing statements are statements that are placed in a statistically different position on the Q-sort grid by participants that load onto a given factor, to where participants that load on other factors have placed the same statement.

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Appendix 7.5: Correlations Between Factor Scores

Factor	1a	1b	2
1a	1.0000	-0.7168	0.5873
1b	-0.7168	1.0000	-0.2487
2	0.5873	-0.2487	1.0000